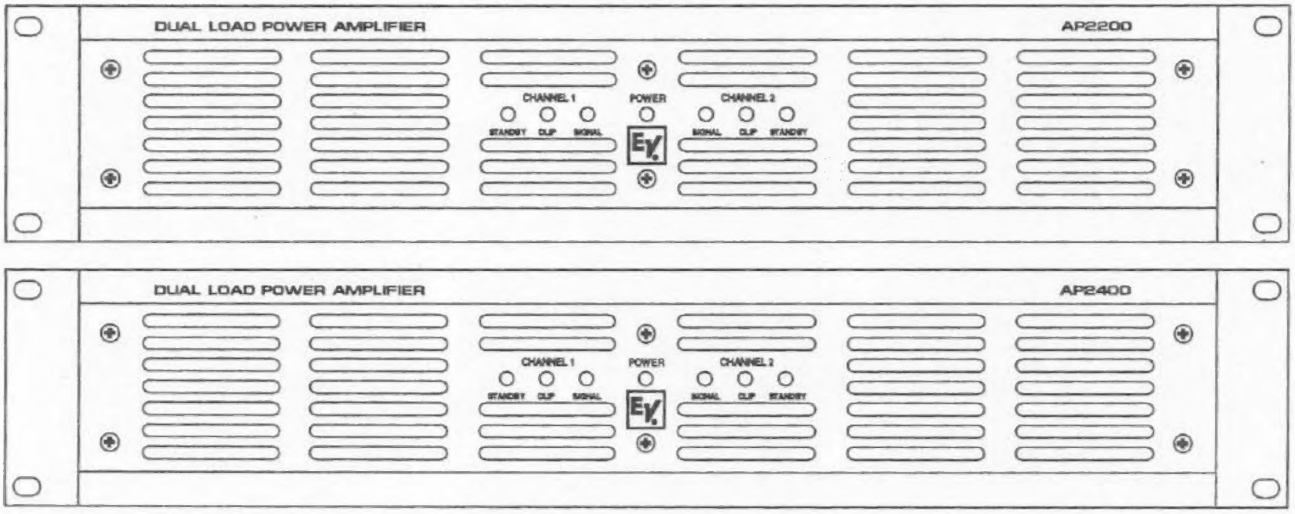
Electro-Voice®

OPERATION MANUAL & SERVICE INSTRUCTIONS

AP2200 & AP2400 AMPLIFIERS



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Uniform Limited Warranty Statement

Electro-Voice® products are guaranteed against malfunction due to defects in materials or workmanship for a specified period, as noted in the product-line statement(s) below, or in the individual product data sheet or owner's manual, beginning with the date of original purchase. If such malfunction occurs during the specified period, the product will be repaired or replaced (at our option) without charge. The product will be returned to the customer prepaid.

Exclusions and Limitations: The Limited Warranty does not apply to: (a) exterior finish or appearance; (b) certain specific items described in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual; (c) malfunction resulting from use or operation of the product other than as specified in the product data sheet or owner's manual; (d) malfunction resulting from misuse or abuse of the product; or (e) malfunction occurring at any time after repairs have been made to the product by anyone other than Mark IV Audio Service or any of its authorized service representatives.

Obtaining Warranty Service: To obtain warranty service, a customer must deliver the product, prepaid, to Mark IV Audio Service or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice. A list of authorized service representatives is available from Mark IV Audio Service at 600 Cecil Street, Buchanan, MI 49107 (800-234-6831 or FAX 616-695-4743).

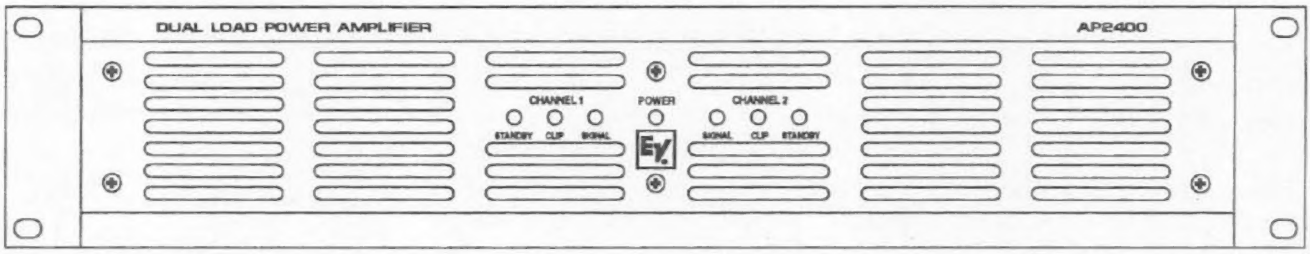
Incidental and Consequential Damages Excluded: Product repair or replacement and return to the customer are the only remedies provided to the customer. Electro-Voice® shall not be liable for any incidental or consequential damages including, without limitation, injury to persons or property or loss of use. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.

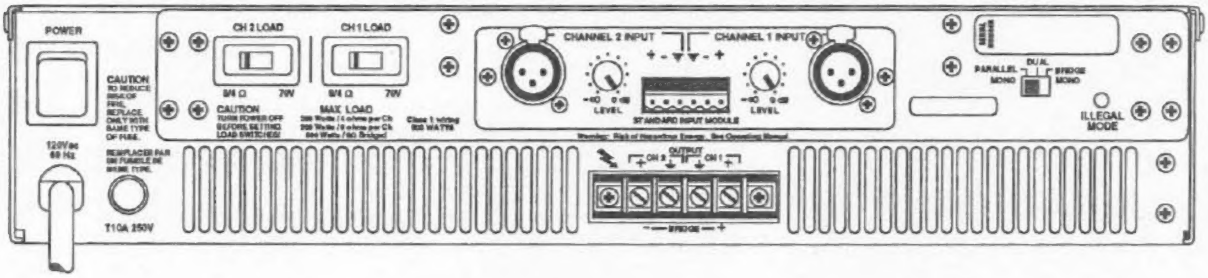
Other Rights: This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Electro-Voice® Electronics are guaranteed against malfunction due to defects in materials or workmanship for a period of three (3) years from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

PRODUCT DESCRIPTION

The Electro-Voice® AP2200 / AP2400 series amplifiers are designed for direct voice-coil drive and/or 70-volt distributed systems. Each channel can be independently configured for 70-volt line operation or 8/4-ohm systems. The two channels together can be paralleled or bridged for driving a single load. This series features an ultraquiet continuously variable cooling system which pulls air from front to back. An air filter is provided and can be removed from the front for cleaning. The input module is removable and comes standard with both XLR and screw terminal connectors. Optional accessories for signal processing plug into the input module. Optional control modules allow compatibility and connection to an Interactive Technology network. Each channel is protected against load shorts, overtemperature and output dc. The front panel indicators provide signal present, signal clip and standby for each channel as well as a power on indicator.





UNPACKING

This shipping carton is specially designed to protect the amplifier while transporting under normal conditions. It is still possible for damage to occur so carefully inspect the outside carton for signs of abuse. If for any reason the amplifier should be returned, use the shipping carton that it came in. Electro-Voice®cannot warranty against damage that occurs as a result of improper packaging.

PRECAUTIONS

Do not replace the fuse with a higher amp rating than what is specified. There are various circuits inside that detect fault conditions and place the amplifier in standby (indicated on the front panel by the amber LEDs). A blown ac panel fuse indicates a more severe problem such as a transformer failure. An oversized fuse installed under these conditions can lead to a possible fire hazard.

There is a thermal fuse located inside the transformer primary windings to protect against unusual conditions that the amplifier fault logic may not sense. For example, a leaky power supply capacitor can cause excessive current to flow therefore heating up the transformer, yet the amplifier appears to perform normally. If the amplifier is operating under extreme conditions that cause the transformer to overheat, it is possible for this thermal fuse to trip before either the back panel fuse blows or the amplifier engages a standby condition. In this case, the internal transformer fuse will remain open (no power) until the temperature inside the transformer drops to a safe level. At that time the fuse will close and power will again be applied. This shut-down condition can be recognized by a total power lost even though the panel fuse is good. This contrasts against a thermal shut-down by the fault logic where the power and stand-by LEDs on the front panel are brightly lit and the internal fan may be running.

SPECIFICATIONS

All output power specifications are for < 0.1% THD, 20-20kHz, both channels driven (30kHz measurement bandwidth).

RATED POWER: (Watts)	AP2200	AP2400
Dual Mode		
4-ohm	150	250
8-ohm	100	200
70-volt	100	200
Parallel Mono		
2-ohm	300	500
4-ohm	200	400
8-ohm	100	200
70-volt	200	400
Bridged Mono		
8-ohm	300	500
16-ohm	200	400
140-volt	200	400

FREQUENCY RESPONSE

10 Hz to 80kHz (ref. 1kHz, 1 watt output, + 0/-3 dBr)

POWER BANDWIDTH

20Hz to 20kHz
(ref. 1kHz, +0/-.5 dBr where 0 dBr = rated output power in any mode)

VOLTAGE GAIN: (ref. 1 kHz)	AP2200	AP2400
Dual Mode		
4/8-ohm	31.2 dBu	34.2 dBu
70-volt	39.2 dBu	39.2 dBu
Parallel Mono		
2/4/8-ohm	31.2 dBu	34.2 dBu
70-volt	39.2 dBu	39.2 dBu
Bridged Mono		
8/16-ohm	37.2 dBu	40.2 dBu
140-volt	45.2 dBu	45.2 dBu

SIGNAL TO NOISE: > 100 dBr (A wtd.) measured below rated output
THD: < 0.1% 20-20 kHz for rated power
(any mode, 30kHz measurement bandwidth)

SENSITIVITY	AP2200	AP2400
8 ohm / 70 V / 140 V	0 dBu (0.775 Vrms)	0 dBu (0.775 Vrms)
4Ω / 2Ω / 8Ω brg	-1.2 dBu (0.647 Vrms)	-2 dBu (0.616 Vrms)

INPUT IMPEDANCE: 20k Ohms
SOURCE IMPEDANCE: 0.032 Ohms
CROSS TALK: < -70 dB at 1kHz
DC OFFSET: Less than 5 mV
SLEW RATE: 15 V/uS
DAMPING FACTOR: > 300 (1 kHz, 8-ohm)
AC POWER: 120 V ac / 60 Hz
MINIMUM AC VOLTAGE: 95 V ac / 60 Hz

POWER CONSUMPTION AND THERMAL DISSIPATION

The following tables provide guidelines for estimating heat dissipation of each amplifier, given it's intended application. This data is based on the following equation:

Pdis = Pac - Pld

Pdis = Power Dissipated in Watts
Pac = True AC Mains Power in Watts Consumed
Pld = Total Average Power Delivered to the Load

The applications are as follows:

Idle: The amplifier is on with no signal present.
Paging/Background Music: The amplifier is operating with one second announcements (at full power) every 15 seconds or back ground music which is attenuated -32 dBr.
Continuous Speech: The amplifier is operating with continuous speech that is attenuated -23 dBr.
Dynamic: The amplifier is operating with a dynamic input signal such as a motion-picture sound track or classical music. Loud passages are at full power, soft passages are equivalent to continuous speech.
Full Music Power: The amplifier is operating with continuous music input at rated output to the load with only occasional clipping.

Conditions for following measurements:
Line = 120 V ac • Both channels driven equally and with equal loads for dual mode measurements

AP2200

Line Current, Power Consumed/Dissipated and Output for selected applications

Application: Idle						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	.37	26	0	26	89	22
4 ohm Dual	.41	29	0	29	99	25
8 ohm Dual	.41	29	0	29	99	25
8 ohm Bridged	.43	30	0	30	102	26
70 V Dual	.54	38	0	38	130	33
70 V Parallel	.50	35	0	35	120	30
140 V Bridged	.54	38	0	38	130	33
Application: Paging/Background Music						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	.76	48	.27	47.7	163	41
4 ohm Dual	.81	51	.27	50.7	173	44
8 ohm Dual	.63	40	.18	39.8	136	34
8 ohm Bridged	.81	51	.27	50.7	173	44
70 V Dual	.70	44	.18	43.8	150	38
70 V Parallel	.66	42	.18	41.8	143	36
140 V Bridged	.70	44	.18	43.8	150	38
Application: Continuous Speech						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	1.35	104	3	101	345	87
4 ohm Dual	1.39	107	3	104	355	89
8 ohm Dual	.95	73	2	71	242	61
8 ohm Bridged	1.38	106	3	103	352	89
70 V Dual	.88	68	2	66	225	57
70 V Parallel	.86	66	2	64	219	55
140 V Bridged	.88	68	2	66	225	57
Application: Dynamic						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	2.60	226	15.9	210	717	181
4 ohm Dual	2.43	210	15.9	194	663	167
8 ohm Dual	1.75	145	13	132	451	114
8 ohm Bridged	2.45	212	15.9	196	669	169
70 V Dual	1.52	122	13	109	372	94
70 V Parallel	1.50	120	13	107	365	92
140 V Bridged	1.51	123	13	110	375	95
Application: Full Music Power						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	3.59	335	48	287	980	247
4 ohm Dual	3.68	344	48	296	1011	255
8 ohm Dual	2.27	212	32	180	615	155
8 ohm Bridged	3.65	341	48	293	1001	252
70 V Dual	1.88	175	32	143	488	123
70 V Parallel	1.84	172	32	140	478	120
140 V Bridged	1.88	175	32	143	488	122

AP2400

Line Current, Power Consumed/Dissipated and Output for selected applications

Application: Idle						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	.44	29	0	29	99	25
4 ohm Dual	.55	42	0	42	143	36
8 ohm Dual	.55	42	0	42	143	36
8 ohm Bridged	.52	36	0	36	123	31
70 V Dual	.58	45	0	45	154	39
70 V Parallel	.50	35	0	35	120	30
140 V Bridged	.60	47	0	47	161	41
Application: Paging/Background Music						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	.85	65	.45	64.5	220	55
4 ohm Dual	.75	58	.45	57.5	196	49
8 ohm Dual	.90	70	.36	69.6	238	60
8 ohm Bridged	.89	70	.45	69.5	237	60
70 V Dual	.78	62	.36	61.6	210	53
70 V Parallel	.74	58	.36	57.6	197	50
140 V Bridged	.77	61	.36	60.6	207	52
Application: Continuous Speech						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	1.87	154	5	149	508	128
4 ohm Dual	1.94	161	5	156	533	134
8 ohm Dual	1.41	113	4	109	372	94
8 ohm Bridged	1.91	159	5	154	526	133
70 V Dual	1.40	113	4	109	372	94
70 V Parallel	1.38	110	4	106	362	91
140 V Bridged	1.38	111	4	107	365	92
Application: Dynamic						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	3.55	317	26.3	291	994	250
4 ohm Dual	3.60	321	26.3	295	1007	254
8 ohm Dual	2.53	218	21.2	197	673	170
8 ohm Bridged	3.60	321	26.3	295	1007	254
70 V Dual	2.46	208	21.6	186	635	160
70 V Parallel	2.42	204	21.6	182	622	157
140 V Bridged	2.47	210	21.6	188	642	162
Application: Full Music Power						
Load	Line Current (A)	Pac (W)	Pld (W)	Pdi (W)	Btu/Hr	Kcal/Hr
2 ohm Parallel	5.50	520	80	440	1503	379
4 ohm Dual	5.65	535	80	455	1554	391
8 ohm Dual	3.93	353	64	289	987	249
8 ohm Bridged	5.61	535	80	455	1554	392
70 V Dual	3.72	332	64	268	915	231
70 V Parallel	3.72	331	64	267	912	230
140 V Bridged	3.65	325	64	261	891	225

PHYSICAL:	AP2200	AP2400
Depth:	16 in. (406.4mm)	16 in. (406.4mm)
Width:	19 in. (482.6mm)	19 in. (482.6mm)
Height:	3.4 in. (88.1mm)	3.4 in. (88.1mm)
Weight:	29.75 lb (13.49 kg)	30.75 lb (13.95 kg)
Shipping Weight:	33.87 lb (15.36 kg)	34.87 lb (15.81 kg)

INPUT CONNECTIONS

Balanced input connections may be made to either the wire terminals or the XLR connectors. For single-ended unbalanced signal sources, the negative terminal (pin 3 of the XLR) should be connected to ground (pin 1 of the XLR). The screw terminal connections are wired directly to the XLR pins. XLR pin 1 corresponds to the screw terminal marked with a ground symbol. XLR pins 2 and 3 correspond to the terminals marked "+" and "-" respectively. The screw terminals may be used for an auxiliary output if the input signal is to be routed to multiple amplifiers. Another application for the screw terminals is to provide a convenient place for a termination resistor. A 600 ohm resistor connected across the "+" and "-" screw terminals is equivalent to loading pins 2 and 3 of the XLR input. Refer to Figure 1 for typical connections.

XLR PIN 1 GROUND JUMPER

To help facilitate various grounding connections for pin 1 of the XLR connectors (and the input terminal ground), a three pin jumper is provided on the standard input module. The jumper is located near the channel two XLR connector. This jumper connects pin 1 of both XLR connectors to either the chassis ground (indicated by the earth symbol) or signal ground (indicated by the triangle symbol). The unit is shipped with pin 1 connected to the chassis. This position offers the best isolation from ground loops and noise if you use a uniformly shielded twisted pair cable that does not include a drain wire. You should only use the signal ground position if you are using unbalanced signal sources.

Figure 1a *Balanced source using header input*

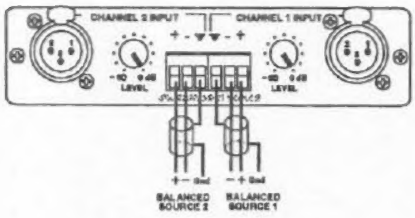


Figure 1b *Unbalanced source using header input*

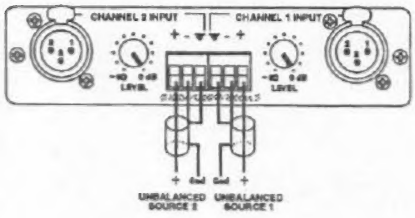


Figure 1c *Alternate connection for unbalanced sources using header input*

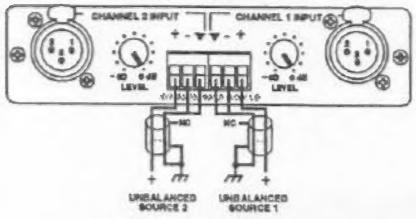


Figure 1d *Balanced source with auxiliary out*

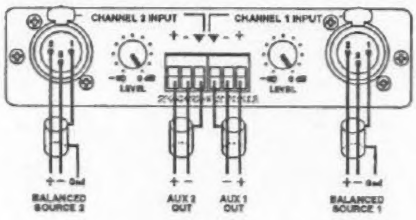


Figure 1f *Unbalanced source with auxiliary out*

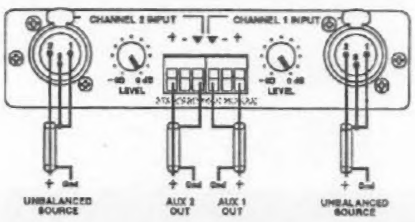


Figure 1e *Balanced source with termination resistors*

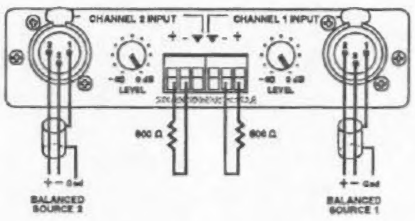
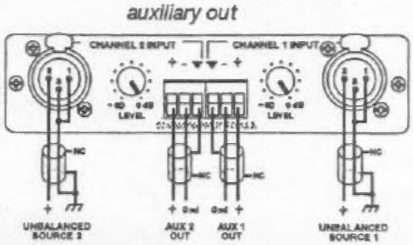


Figure 1g *Alternate connection for unbalanced sources with auxiliary out*



OUTPUT CONNECTIONS, CONFIGURATIONS

Speaker output connections are made to the four-terminal barrier-strip connector located below the input module. The output configurations are determined by the three-position mode switch located to the right of the input module, and the load switches located to the left of the input module.

Caution: Replace output cover after speakers are connected. Do not expose bare wires and terminals.

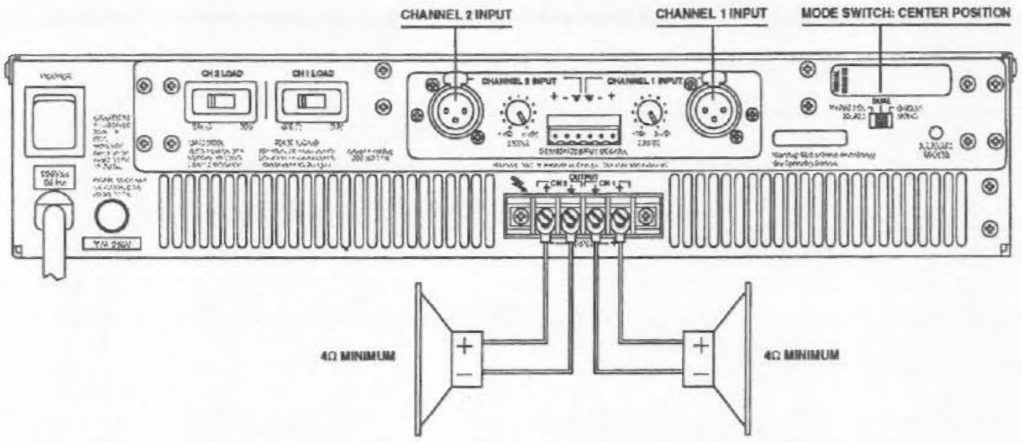


Figure 2a *Dual (Stereo) Mode Connections*

Dual Mode - In this configuration the amplifier is operating as two independent power amplifiers. Each speaker load can be independently configured for 8/4-ohm or 70-Volt line operation using the load switches located to the left of the input module (Figure 2a).

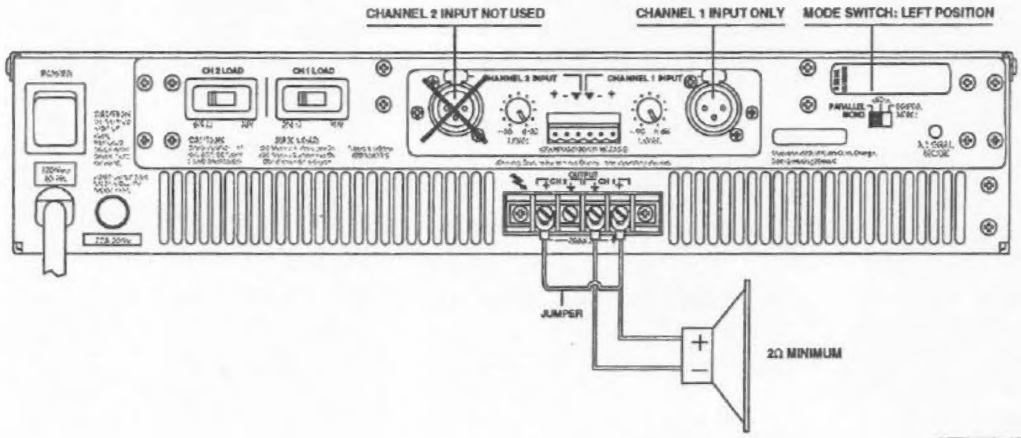


Figure 2b *Parallel Mono Connections*

Parallel Mono - This configuration provides the means to increase the current delivered to a single speaker load by shorting the outputs together (Figure 2b). Both channels are combined to create one power amplifier that has the equivalent power capacity of both channels. Do not make the mistake however of assuming that for example, an AP2400 in parallel mono mode driving a single 8-ohm load will deliver 400 watts. It will still deliver 200 watts with a 0 dBu input signal. The advantage of parallel mono is the ability to double the power into a 4-ohm load (400 watts) as well as deliver still more power into 2 ohms (500 watts) without overheating or current limiting. For distributed 70-volt line applications, parallel mono mode allows loading the amplifier for the full rated power of both channels on a single 70-volt line. The signal source is connected to the channel-one input only. The channel-2 input is disabled.

WARNING: The load switches must be set in tandem when operating in parallel mono mode. If one load switch is set for 70-volt and the other is set for 8/4 ohms while in this mode, the protection logic will disable channel one. See "ILLEGAL MODE" for more information.

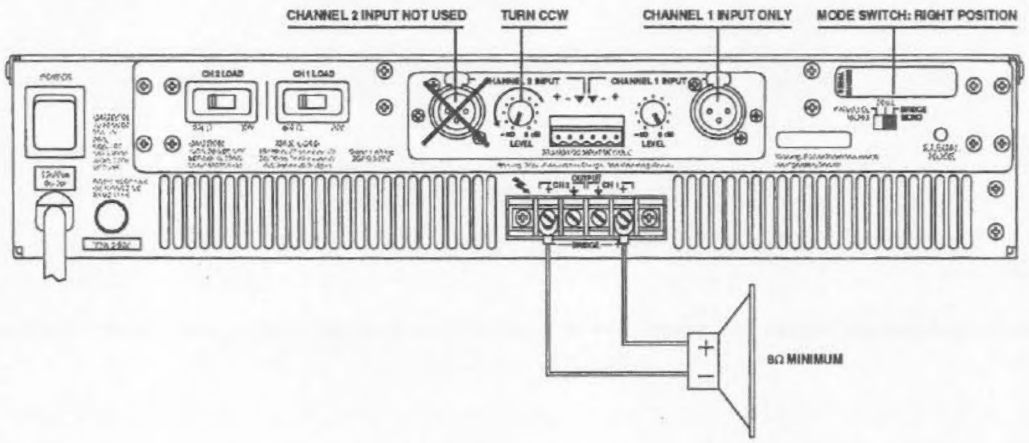


Figure 2c *Bridged Mono Connections*

CAUTION: Unlike the other modes where the speaker load has one terminal connected to ground, bridged mono mode provides a differential "floating" signal to the speaker load and therefore any test equipment that is used to measure this signal should also have a floating ground.

WARNING: The load switches must be set in tandem when operating in bridged mono mode. If one load switch is set for 70-volt while the other is set for 8/4 ohms while in this mode, the protection logic will disable channel one. See "ILLEGAL MODE PROTECTION" for more information.

Bridged Mono - In this mode a single speaker load is connected across the amplifier outputs (Figure 2c). For proper operation the signal source is connected to the channel-one input. The channel-two input level should be fully counterclockwise. In this mode the amplifier is providing a true balanced output.

For 8/4-ohm load configuration, the load impedance should not be less than 8 ohms. A 70-volt load configuration in bridged mono mode allows driving a 100-volt distributed system* or a 140-volt system.

**input sensitivity must be adjusted to -3 dBu (0.549 V rms)*

ILLEGAL MODE PROTECTION

Illegal mode protection is provided to guard against an improper mono-mode setting. When the amplifier is set in either bridged or parallel mono, both amplifiers are combined as one power stage to drive the speaker load. It is necessary that each amplifier's load switch is configured identically since both amplifiers are driving the same load. To avoid problems, the protection logic will sense an improper condition and disable channel one. Channel two is also disabled since channel two is driven by channel one. The channel 1 Standby LED on the front panel will turn on. In addition the "ILLEGAL MODE" LED on the rear panel will also turn on. The amplifier will remain in this mode until both load switches are identically set, or dual mode is selected.

70 VOLT OPERATION

70-volt line operation provides a means to drive multiple sets of speakers without the confusion and complexity of adjusting the final load impedance. The term 70-volt refers to the output rms voltage delivered by the amplifier. By comparison, the output voltage for an AP2400 into an 8-ohm load with an input of 0 dBu is 40 volts rms. When the amplifier load switch is changed to the 70-volt position, two things happen. One is that the gain is increased so that an input of 0 dBu results in an output of 70.7 volts rms. The second is that the amplifier power supply voltage is adjusted to accommodate this output level.

This type of system requires a speaker that includes a small power converting transformer. Each speaker is rated not by its load impedance but by the power that it consumes from the amplifier. For example, if you have speakers that have a 70-volt rating of 10-watts each then you can parallel twenty of these speakers to each channel of an AP2400 amplifier. The total power is evenly distributed among each speaker. Even if several speakers are disconnected from the line, the remaining speakers will still only consume 10 watts each. The power can also be unevenly distributed. For example five 20-watt speakers can be paralleled with ten 10-watt speakers as long as the total power does not exceed that of the amplifier that is driving the 70-volt line. In this case each 20 watt speaker will be 3 dB louder than the 10 watt speakers. The relatively high impedance of a 70-volt line allows longer cable runs to remote speakers (see "OUTPUT CABLE SELECTION", "CALCULATING POWER LOSSES" and "DAMPING FACTOR" for more details on the affects of cable length on a speaker system). Any amplifier that drives a 70-volt line must be capable of providing an output of 200 volts peak to peak. This is why many amplifiers require expensive step-up transformers. The AP2000 series can drive the 70-volt line direct without using step-up transformers. A 140-volt system can be directly driven using the bridged mono mode. A 100-volt system can be driven if the input signal is reduced to -3 dBu (0.549 V rms). A 100-volt system would require speakers that are designed with transformers that have a 100-volt input tap. Likewise a 140-volt system would require speakers that are designed with transformers that have a 140-volt input tap.

WARNING: Do not use the 70-volt position as a method for increasing gain to a low impedance load. When the supply voltage is increased for 70-volt operation, there must be a corresponding increase in the load impedance. Otherwise the resulting high voltage and increased current will cause the amplifier to overheat and shut down.

INSTALLATION

The amplifier may be installed in a standard 19 inch equipment rack. The AP2200 & AP2400 requires 89 mm (3.5 in.) of vertical rack space and 406.4 mm (16 in.) of depth. The amplifiers secure to the rack cabinet with four rack mount screws and cup washers provided in the hardware kit.

VENTILATION

The amplifier must be adequately ventilated to avoid excessive temperature rise. The air is drawn from front to back therefore a rear ventilated cabinet should be used. It should not be used in areas where the ambient temperature exceeds 60° C (140° F). To determine the ambient air temperature, operate the system in the rack until the temperature stabilizes. Measure the ambient air with a bulb-type thermometer held at the bottom of the uppermost amplifier. Do not let the thermometer touch the metal chassis because the chassis will be hotter than the ambient air. If the air temperature exceeds 60° C (140° F), the equipment should be spaced at least 44 mm (1.75 in.) apart or a blower installed to provide sufficient air movement within the cabinet.

WARNING: Do not operate the amplifier within a completely closed unventilated housing.

OUTPUT CABLE SELECTION

Speaker wire size plays an important part in quality sound systems. Small wire gauges can waste power and reduce the damping factor at the speaker terminals. This can add coloration and muddiness to the sound. To help offset this problem Tables I and II have been assembled to enable you to calculate the power losses in the speaker cable.

CALCULATING POWER LOSSES

To calculate the total power loss in the speaker cable, multiply the power loss per foot of the 2-wire cable using the appropriate table below by the length of the cable in feet. For example, suppose an installer uses 160 feet of 12 gauge 2-wire cable with an 8-ohm speaker system connected to an AP2200 amplifier. The total power loss in the cable is:

Total Power Loss = 0.0405 watts/foot x 160 feet = 6.5 watts

Does this mean that whenever the amplifier produces 100 watts of output power, 93.5 watts (100 watts minus 6.5 watts) will be delivered to the 8 ohm load? NO! The actual load impedance is 8 ohms plus the resistance of the cable (0.00324 x 160 feet + 8 = 8.52 ohms). Because of the change in the load impedance, the actual total power produced by the amplifier is 93.9 watts. The power delivered to the load is approximately 93.9 watts minus 6.5 watts or 87.4 watts.

TABLE I *AP2200 Power Losses per foot in 2-wire Speaker Cable*

Ω / AWG	2 (300W)*	4 (150W) 8 (300W)**	8 (100W)	16 (50W)	70V(100W) 140V(200W)**
6	0.1214	0.0303	0.0101	0.0025	0.0016
8	0.1813	0.0453	0.0151	0.0038	0.0024
10	0.3054	0.0764	0.0255	0.0064	0.0041
12	0.4844	0.1213	0.0405	0.0101	0.0065
14	0.7685	0.1926	0.0643	0.0161	0.0103
16	1.2185	0.3058	0.1022	0.0256	0.0164
18	1.9278	0.4851	0.1622	0.0406	0.0260
20	3.0417	0.7682	0.2574	0.0645	0.0414
22	4.7794	1.2144	0.4081	0.1025	0.0658

** Parallel Mono **Bridged Mono*

TABLE II *AP2400 Power Losses per foot in 2-wire Speaker Cable*

Ω / AWG	2 (500W)*	4 (250W) 8 (500W)**	8 (200W)	16 (100W)	70V(200W) 140V(400W)**
6	0.2023	0.0506	0.0202	0.0051	0.0065
8	0.3021	0.0756	0.0302	0.0076	0.0097
10	0.5090	0.1274	0.0510	0.0127	0.0163
12	0.8074	0.2022	0.0809	0.0202	0.0235
14	1.2809	0.3211	0.1286	0.0322	0.0412
16	2.0308	0.5098	0.2043	0.0511	0.0655
18	3.2130	0.8085	0.3244	0.0812	0.1041
20	5.0695	1.2805	0.5148	0.1290	0.1653
22	7.9656	2.0240	0.8163	0.2049	0.2627

** Parallel Mono **Bridged Mono*

DAMPING FACTOR

The higher the damping factor of an amplifier, the greater the ability of the amplifier to control unwanted speaker cone movements. When a signal drives a woofer, current flowing through the voice coil creates a magnetic field. This field interacts with the permanent magnetic field in the gap and forces the combination cone and voice coil assembly to move outward. When the signal is removed, the assembly moves inward but its momentum causes it to overshoot its resting point. This overshoot will dampen itself out eventually but the unwanted movements can add considerable distortion to the sound. In the process of moving inward through the magnetic field, the voice coil assembly generates a current of opposite polarity to the original signal. This current induces a voltage or "back EMF" which travels through the speaker wire to the amplifier's output. The lower the amplifier source impedance, the faster the overshoot of the voice coil will dampen out. The source impedance of an amplifier can be calculated by dividing the rated output impedance, typically 8 ohms, by the damping factor. The source impedance of the AP2200 and the AP2400 is 0.032 ohms.

Cable Selection for Specified Damping Factor at the Load.
The damping factor rating of the amplifier is typically never realized at the load because of the resistance of the cable. The damping factor at the load should be 30 for general paging systems and 50 for high-fidelity music systems. Economics usually dictate however that these numbers are cut in half. The resulting damping factor at the load should be based on experience and customer satisfaction. Once a minimum damping factor is determined for a particular type of installation, the following equation can be used to calculate the maximum length of two-wire cable which can be used to achieve the minimum damping factor specified at the load:

$$\text{Max Length} = \frac{\frac{ZL}{DF} - Zo}{DCR}$$

ZL = load impedance
Zo = Amplifier source impedance
DF = minimum permissible damping factor
DCR = dc resistance per foot of the 2-wire cable (Table III)
For 70-volt systems ZL can be approximated as:

$$ZL = 70.7^2/Pout$$

Pout = Amplifier rated power
For 100-volt systems ZL = 100^2/Pout
For 140-volt systems ZL = 141.4^2/Pout

Suppose ZL equals 8 ohms, Zo = 0.032 ohms (AP2400) and the minimum damping factor at the load is to be 25. In addition, 18 GA cable is preferred. Then the maximum length of cable which can be used to achieve a damping factor of 25 at the load is:

$$\text{Max Length} = ((8/25)-0.032)/0.01302) = 22.1 \text{ feet}$$

Suppose you would like to calculate the maximum length of 2-wire cable using the same conditions as above except now you are using a 70V system instead of an 8 ohm system. For a 200 watt 70-volt system, ZL = 70.7^2/200 = 25 ohms. Using the above calculation for a minimum DF of 25:

$$\text{Max Length} = ((25/25)-0.032)/0.01302 = 74.3 \text{ feet}$$

A 140-volt 200 watt system using the same conditions as above would allow over 298 feet of 18 gauge cable. Note that in each case, the total power loss in the

TABLE III

AWG	DCR (Ω/ft)	DCR (Ω/m)
6	0.00081	0.00264
8	0.00121	0.00421
10	0.00204	0.00669
12	0.00324	0.01063
14	0.00515	0.01691
16	0.00819	0.02685
18	0.01302	0.04289
20	0.02070	0.06764
22	0.03292	0.10658

cable is roughly the same (between 7 and 8 watts) even though the cable length was extended from 22.1 to 298 feet! This illustrates the advantage of high-voltage systems for distributed sound.

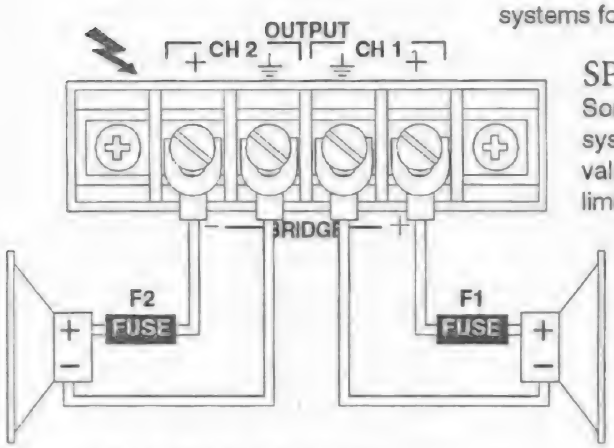


Figure 3a *Optional protection fuse connection*

SPEAKER PROTECTION

Sometimes it may be desirable to use in-line fuses to protect loudspeaker systems (Figure 3a). It is difficult however to determine the proper fuse value with the correct time lag and overload characteristics to match the limitations of a speaker system. Fuse values are shown for the given power and load in Table IV. The values are calculated for fast-blow fuses which carry 135% of their current rating for an hour but will blow within 1 second at 200%. Other fuse values may be calculated for different power levels from the following equation:

$$\text{Fuse Value} = \frac{\sqrt{\text{Pout} \cdot \text{ZL}}}{\text{ZL} \cdot 1.35}$$

Pout = rated power of amplifier
ZL = load impedance

TABLE IV *Speaker Protection Fuse Chart*

Power (Watts)	4Ω	8Ω	16Ω
100	3.70	2.62	1.85
150	4.54	3.21	2.27
200	5.24	3.70	2.62
300	6.42	4.54	3.21
400	7.41	5.24	3.70
600	9.07	6.42	4.54

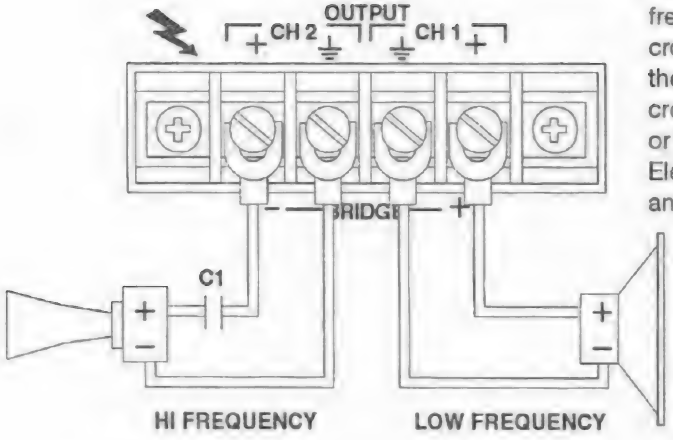


Figure 3b *BiAMP connection with compression driver protection capacitor*

Compression drivers are much more susceptible to damage from low frequencies than large cone loud-speakers. Even though an electronic crossover may be employed, problems may arise in the cables between the crossover and the power amplifier, or from misadjustment of the crossover. Either of these situations could apply low frequency signals or hum to the driver and cause damage. To prevent a potential problem, Electro-Voice® recommends using a capacitor between the amplifier and the compression driver to suppress low frequencies and possible dc. Refer to the example in Figure 3b.

In choosing a value, one must be careful not to interfere with the crossover frequency. As a general rule, select a capacitor whose break frequency with respect to the load is 3 dB down at approximately 1/2 of the high pass corner frequency. Mylar capacitors with at least a 100 volt ac rating are recommended. Table V shows the recommended capacitor values for use with 8 and 16-ohm drivers at common crossover frequencies.

TABLE V. *Protection Capacitor Sizes for Common Cross-Over Frequencies*

X-over Freq	8 Ohm	16 Ohm
500 HZ	80 uF	40 uF
800 HZ	50 uF	25 uF
1000 HZ	40 uF	20 uF
1250 HZ	33 uF	16 uF
2000 HZ	20 uF	10 uF
3150 HZ	12 uF	6 uF
6300 HZ	6 uF	3 uF

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Notice: Modifications to Electro-Voice® products are not recommended. Such modifications shall be at the sole expense of the person(s) or company responsible, and any damage resulting therefrom shall not be covered under warranty or otherwise.

Note: If you need to verify the performance of the amplifier against the rated specifications, you must be able to maintain the ac line voltage constant at 120 V ac. Therefore, we recommend a suitably rated variac (50 ampere rating at 120 V ac).

DC OFFSET TRIM PROCEDURE

The following adjustments are best performed after the amplifier has warmed up. First remove the top cover by the 6 access screws along the front and back (Figure 4). Refer to figure 5 for the following procedure.

1. With the amplifier in dual mode, turned on and no signal, locate trim pot R7 on the Driver PCB
2. Adjust for an output of zero volts dc, +/- 1 mV, measured at the channel-1 output speaker terminals.
3. Repeat step 2 adjusting R26, measured at the channel-2 output speaker terminals.

IDLE CURRENT TRIM PROCEDURE

The following adjustments are made on the main power amplifier board. This board can be exposed by removing the four access screws at the four corners on the rear panel and raising the driver board assembly (Figure 4). Each channel is a grounded bridge configuration. Since a grounded bridge consists of 2 amplifier stages for each output, there are 2 independent idle adjustments for each channel. One is for the high side amplifier that drives the positive output terminal and the other is for the low side amplifier which sinks or sources the return path (ground terminal). Refer to Figure 6 for the following procedures.

1. The Channel-1 high side bias is adjusted with R102 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R108.
2. The Channel-1 low side bias is adjusted with R125 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R122.
3. The Channel-2 high side bias is adjusted with R202 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R208.
4. The Channel-2 low side bias is adjusted with R225 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R222.

NOTICE: Repairs performed by other than authorized warranty stations (Dealers) or qualified personnel shall void the warranty period of this unit. To avoid loss of warranty, see your nearest Electro-Voice® authorized dealer, or call Mark IV Audio Service directly at 1-800-234-6831, or FAX (616) 695-4743 or write:

Mark IV Audio Service
600 Cecil Street
Buchanan, MI 49107
USA

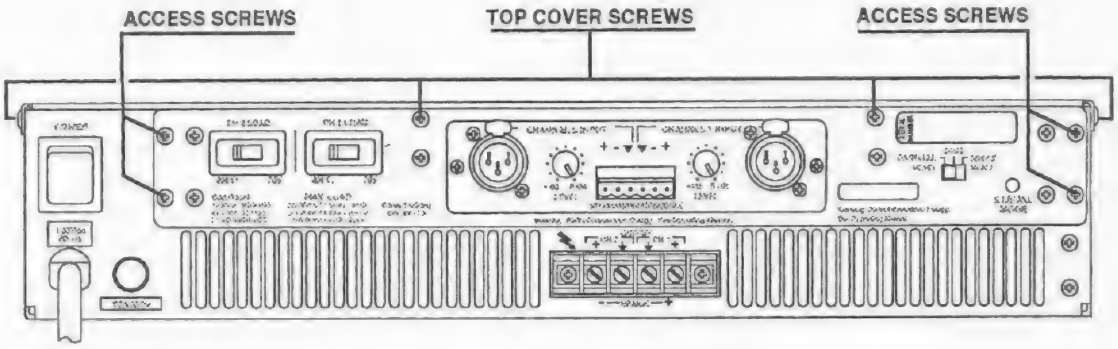


Figure 4 *Access screws*

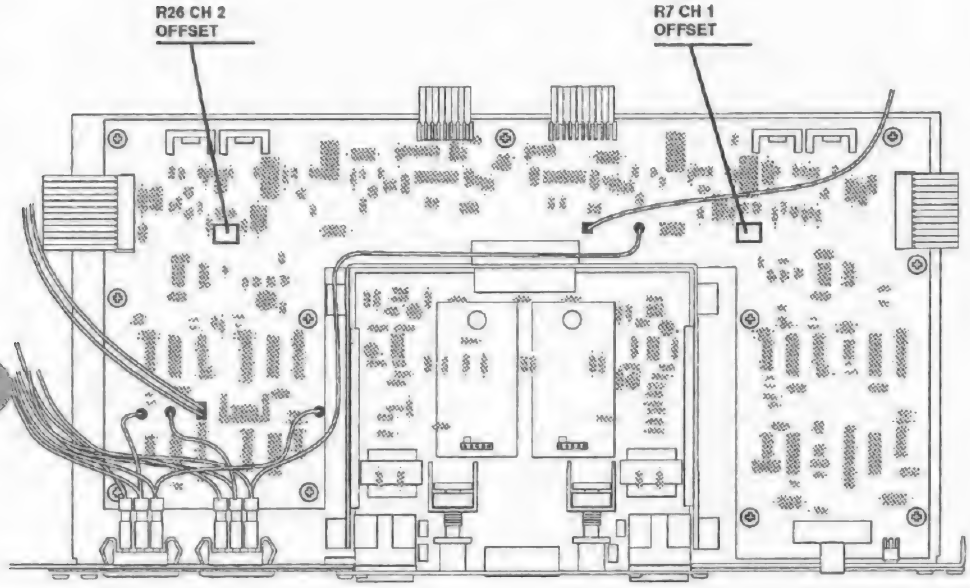


Figure 5 *DC bias trim pot locations*

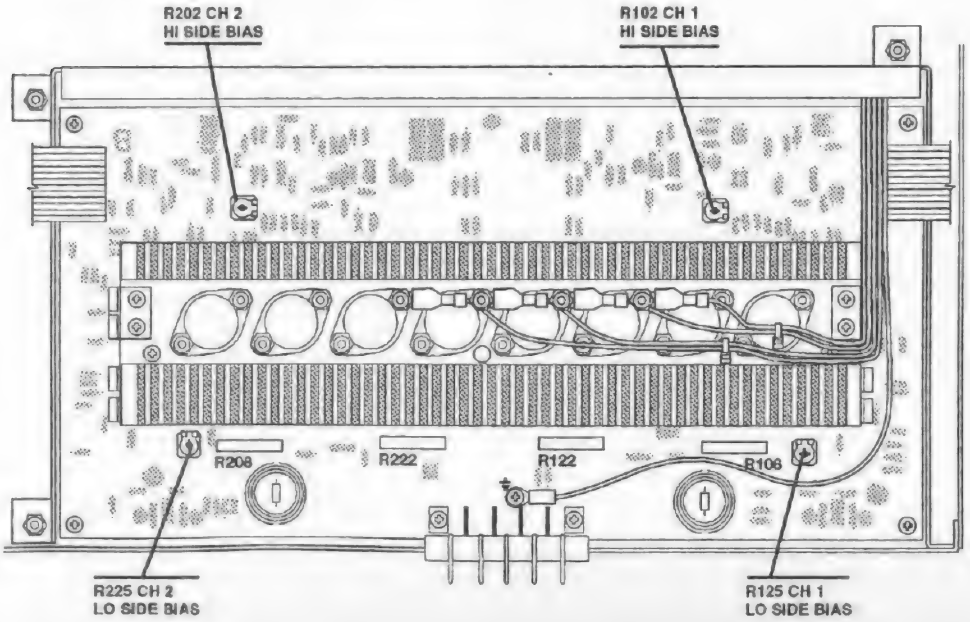
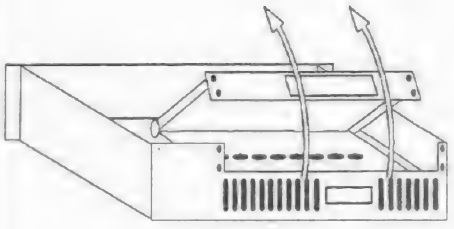


Figure 6 *Idle current trim pot locations*



AP2200 & AP2400 COMPONENT PARTS LIST

ORDERING REPLACEMENT PARTS

To order replacement parts, look up the ordering part number from the component parts listing and call 1-800-234-6831 or Fax 616-695-4743

REFERENCE	PART NUMBER	DESCRIPTION
PCB POWER AMPLIFIER (27-01-050994)		
SEMICONDUCTORS		
U101,201	17-01-039252	NE5534AN Low noise op amp
U100,200	17-01-124462	TL071CP Single Op Amp
D100,101,200,201	48-01-122601	1N4448 Diode
D102-107,113,115	48-01-125067	1N4937 Diode
D202-207,213,215	48-01-125067	1N4937 Diode
D108-112,114	48-02-042787	1N4004 Diode
D208-212,214	48-02-042787	1N4004 Diode
U102,202	48-03-039392	LM35DZ Temp sensor
Q100,200	48-03-039704	MPSA18 NPN transistor
Q111,211	48-03-039705	MJE340 NPN driver transistor
Q112,212	48-03-039706	MJE350 PNP driver transistor
Q101,201	48-03-107102	2N3906 PNP transistor
Q102,202	48-03-121306	2N3904 NPN transistor
Q105,107,205,207	48-03-122978	MJ15024 NPN Power transistor
Q106,108,206,208	48-03-122979	MJ15025 PNP Power transistor
Q104,110,204,210	48-03-051553	2SA1668 PNP Driver Transistor
Q103,109,203,209	48-03-051554	2SC4382 NPN Driver Transistor
RESISTORS		
R113,114,120,121	47-01-039747	2.7 Ohm 1W 5% Flameproof
R213,214,220,221	47-01-039747	2.7 Ohm 1W 5% Flameproof
R105,110,205,210	47-03-124676	1.21 k .25W/1%
R101,201	47-03-122868	1.33k .25W/1%
R128,129,228,229	47-01-102088	2.7k .25W/5%
R127,227,139,140	47-01-039390	200 Ohm .5W/5%
R239,240	47-01-039390	200 Ohm .5W/5%
R106,109,206,209	47-01-102298	27k .5W/5%
R118,218	47-03-028226	66.5k .25W/1%
R134,234	47-03-037660	3.32k .25W/1%
R136,236	47-03-037662	3.65 k .25W/1%
R133,233	47-03-039391	33.2k .5W/.1%
R135,138,235,238	47-03-051175	36.5k .5W 1%
R107,207	47-03-121457	110k .25W/1%
R119,126,130,219	47-03-109437	10K .25W 1%
R226,230	47-03-109437	10K .25W 1%
R103,111,116,131	47-03-121532	1K .25W 1%
R132,137	47-03-121532	1K .25W 1%
R203,211,216,231	47-03-121532	1K .25W 1%
R232,237	47-03-121532	1K .25W 1%
R104,112,123,124	47-01-051289	100 Ohm 1W / 5% Flame P
R204,212,223,224	47-01-051289	100 Ohm 1W / 5% Flame P
R100,200	47-03-124697	3.24k .25W/1%
R117,217	47-03-124648	1.78k .25W/1%
R102,125,202,225	47-06-125036	250 Ohm Trim
R108,122,208,222	47-09-125029	.22 X 2 5% 5W Ceramic
W01-70	21-01-110310	Jmpr Circuit
CAPACITORS		
C100,101,200,201	15-06-124587	.001uF 100V poly
C103,203	15-01-124503	100uF/50V Alum Elec
C107,108,207,208	15-02-100018	47pF 100V ceramic
C109,112,209,212	15-02-106367	68pF 200V
C110,210	15-02-107532	330pF 200V ceramic
C102,202	15-06-038149	0.022uF 100V Metalized Pol
C105,106,205,206	15-06-039383	0.1uF 400V Metalized Poly
C104,111,113,115	15-02-122891	0.1uF 50V Ceramic Radial
C118,120	15-02-122891	0.1uF 50V Ceramic Radial
C204,211,213,215	15-02-122891	0.1uF 50V Ceramic Radial
C218,220	15-02-122891	0.1uF 50V Ceramic Radial
C114,116,119,121	15-01-028691	10uF/50V Alum El
C216,219,221	15-01-028691	10uF/50V Alum El
CONNECTORS		
J100,200	21-01-051176	Header, 12 connector 0.1in
	21-03-050992	Term .25in Spade, screw mnt
J103	21-04-050969	Barr Strip 4 Term PC Mount
HARDWARE		
TO220 driver mntg	28-01-124701	Screw # 4x1/4" ROL PHP BO
TO220 driver mntg	14-08-051177	Bracket, L
TO220 driver mntg	28-04-125012	Wshr Nylon shoulder
TO3 & Term mntg	28-02-114116	Nut, keps 6-32
Term strip mntg	28-01-113868	SCREW 6-32 x 5/16 PHP STL
TO3 mounting	28-01-115520	SCREW 6-32 x 5/8 PHP
TO3 mounting	28-07-051174	Nylon spacer
TO3 mounting	28-03-103639	WSHR #6 Inside star
MISCELLANEOUS		
L100,200	56-01-039697	Inductor 1.85 uH
	14-05-050993	Heatsink Extruded/Cross Flow
	31-02-124568	Insulators TO-3
PCB DRIVER (27-01-051145)		
SEMICONDUCTORS		
U5,6,11,12	17-01-124463	LM339N Quad Comparator
U3,4,9,10	17-01-029028	LM324 Low Pwr Quad Op Amp
U1,U7	17-01-124461	TLO74CN Quad Op Amp
U2,U8	17-01-124462	TLO71CP Single OP Amp
Q30	48-03-121306	2N3904 NPN transistor
Q13	48-03-027336	TIP 32 PNP transistor
Q5,6,8,9,11,12,16	48-03-039707	MPSA42 NPN transistor
Q20,25,26,28,29	48-03-039707	MPSA42 NPN transistor
Q1,3,17,21,24,27	48-03-039708	MPSA92 PNP transistor
Q7,10,18,22	48-03-039705	MJE340 NPN driver transistor
Q2,4,15,19	48-03-039706	MJE350 PNP driver transistor
LED1 illegal mode	39-01-051184	LED Amber
CR2,3,5,6,24,36	48-02-042787	IN4004 Diode
CR29,30,31,32	48-01-125067	1N4937 Diode

REFERENCE	PART NUMBER	DESCRIPTION
CR7,33	48-01-124431	1N5359 24V Zener / 5W
CR1,4,8-23,25-28	48-01-122601	1N4448 Diode
CR34,35,37-48	48-01-122601	1N4448 Diode
1/8 WATT METAL FILM RESISTORS		
R4,9,24,28	47-01-051211	47.5 Ohm .125W 1%
R11,32	47-01-051210	330 Ohm .125W 5%
R165,170,172,176	47-01-051209	560 Ohm .125W 5%
R1,2,3,21,22,23	47-03-051222	1.00 k Ohm .125W 1%
R46,54,78,81,89	47-03-051222	1.00 k Ohm .125W 1%
R124,126,127,134	47-03-051222	1.00 k Ohm .125W 1%
R138,139,140,143	47-03-051222	1.00 k Ohm .125W 1%
R144,145,148,149	47-03-051222	1.00 k Ohm .125W 1%
R150,160,200,201	47-03-051222	1.00 k Ohm .125W 1%
R8,27,121,123	47-03-051221	1.10 k Ohm .125W 1%
R153,155	47-03-051221	1.10 k Ohm .125W 1%
R49,76,84,116	47-01-051208	1.5 k Ohm .125W 5%
R164,169,171,175	47-01-051208	1.5 k Ohm .125W 5%
R125,137,142,147	47-03-051219	2.0 k Ohm .125W 1%
R42,77	47-03-051198	2.43 k Ohm .125W 1%
R41,70, 71, 110, 111	47-01-051207	3.9 k Ohm .125W 5%
R17,20,40,72	47-01-051206	4.7 k Ohm .125W 5%
R112,191,193	47-01-051206	4.7 k Ohm .125W 5%
R195,197	47-01-051206	4.7 k Ohm .125W 5%
R128,151	47-03-051311	9.31 k Ohm .125W 1%
R14,18,30,37,38	47-03-051218	10.0 k Ohm .125W 1%
R48,52,56,62,65	47-03-051218	10.0 k Ohm .125W 1%
R66,69,75,83,87	47-03-051218	10.0 k Ohm .125W 1%
R91,95,96,100,105	47-03-051218	10.0 k Ohm .125W 1%
R106,109,115,117	47-03-051218	10.0 k Ohm .125W 1%
R119,132,133,158	47-03-051218	10.0 k Ohm .125W 1%
R166,167,168,173	47-03-051218	10.0 k Ohm .125W 1%
R174,180,181,183	47-03-051218	10.0 k Ohm .125W 1%
R184,185,186,187	47-03-051218	10.0 k Ohm .125W 1%
R188,189	47-03-051218	10.0 k Ohm .125W 1%
R44,79,136,163	47-03-051217	20.0 k Ohm .125W 1%
R58,93	47-01-051205	27 k Ohm .125W 5%
R47,82	47-01-051204	30 k Ohm .125W 5%
R57,59,92,101	47-01-051203	36 k Ohm .125W 5%
R19,39	47-03-051190	40.2 k Ohm .125W 1%
R94	47-03-051189	41.2 k Ohm .125W 1%
R97	47-03-051224	90.9 k Ohm .125W 1%
R53,55,88,90,122	47-03-051215	100 k Ohm .125W 1%
R131,154,159,177	47-03-051215	100 k Ohm .125W 1%
R178,190,192,194	47-03-051215	100 k Ohm .125W 1%
R196,198	47-03-051215	100 k Ohm .125W 1%
R61,67,99,104,107	47-03-051213	121 k Ohm .125W 1%
R182	47-03-051213	121 k Ohm .125W 1%
R50,63,64,73,85	47-01-051202	470 k Ohm .125W 5%
R102,103,113	47-01-051202	470 k Ohm .125W 5%
R51,86	47-01-051201	1.0 M Ohm .125W 5%
R45,60,68,80,98,108	47-01-051200	2.0 M Ohm .125W 5%
R74, 114	47-01-051199	2.7 M Ohm .125W 5%
R114	47-01-051199	2.7 M Ohm .125W 5%
R120,152	See table in schematics	

REFERENCE	PART NUMBER	DESCRIPTION
R129,156	See table in schematics	
R130,157	See table in schematics	
R141,146	See table in schematics	
MISCELLANEOUS RESISTORS		
R5,25	47-01-039390	200 Ohm .5W 5%
R199	47-01-028008	2.7k Ohm .5W 5% CF
R6,29,135,161,162	47-03-051212	20 k Ohm .5W 1% MF
R118,179	47-01-051310	1.5k Ohm 1W 5%
R7,26	47-06-121916	POT trim 2 k Ohm .5 Watt
CAPACITORS		
C40,41,44,45	15-02-100014	15 pF Ceramic 500V
C1,2,3,5,27,34	15-02-100018	47 pF/ 200V Ceramic
C65,66,69,70	15-02-100018	47 pF/ 200V Ceramic
C30,38,57-60	15-02-100024	100pF/ 200V Ceramic
C55,56	15-02-102603	120pF/ 200V Ceramic
C61-64	15-02-100042	.001uF Ceramic
C10,18	15-06-124691	.0033uF 50V Ceramic
C11,19	15-06-027395	0.01uF 50V Ceramic
C4,6,7,8,9,15,16	15-02-124808	0.1uF 50V Ceramic
C17,21,24,26,33	15-02-124808	0.1uF 50V Ceramic
C35,47,48,49,50	15-02-124808	0.1uF 50V Ceramic
C51-54,72	15-02-124808	0.1uF 50V Ceramic
C39,42,43,46	15-06-039383	.1uF 400V Met Poly
C20,71	15-06-122843	0.33uF 50V Ceramic
C14,22	15-01-124509	2.2uF 50V Electrolytic
C23,25,31,32	15-01-028691	10uF 50V Electrolytic
C28,36	15-01-125026	6.8 uF non-pol Electrolytic
C67,68	15-01-124508	47uF 50V Electrolytic
C29,37	15-01-102611	220uF 16V Electrolytic
CONNECTORS		
P1	21-02-050973	30 Pin connector female
J1	21-01-124829	8 pin Header 0.1" ctrs
J2	21-02-123239	10 pin Header 0.1" ctrs
J3	21-01-123198	2 Pin Header 0.1" ctrs
J100A,200A	21-01-051176	12 pin Header 0.1" ctrs
HARDWARE		
	28-07-051187	Standoff, LED Rt Angle
T0220 hardware	28-01-124701	Screw #4 x 1/4" ROL PHP BO
Drvr xtr hardware	28-02-027389	Nut Keps Hex 4-40
Drvr xtr hardware	28-01-026899	Screw MCH 4-40
MISCELLANEOUS		
K1, K2	45-01-051144	5V Relay DPDT
S1	51-02-050968	Switch 6P3T
	14-05-045222	Htsk Stamped Short
	14-05-027783	Htsk Stamped tall
L1, L2	56-01-121543	2.7 mH
PCB INPUT (27-01-039770)		
SEMICONDUCTORS		
U1,2	17-01-122832	5532A Low noise op amp
RESISTORS		
R7,8,16,17	47-03-121532	1.0k .25 W1%
R1,2,3,4,10,11,12	47-03-109437	10k .25W 1%
R13	47-03-109437	10k .25W 1%
R6,15	47-03-028260	47.5 k .25W 1%

REFERENCE	PART NUMBER	DESCRIPTION
R9,18	47-03-037770	100 .25 W 1%
JMP1-4,7,8	21-01-110310	JMPR CIRCUIT
W01-20	21-01-110310	JMPR CIRCUIT
R5,14	47-06-039484	3k detent potentiometer
	24-04-124526	Knob Screwdriver adjust
CONNECTORS		
J2A,J4A	21-01-037785	XLR Connector pc mount
J3	I170FJ0003	3 conductor Header Rt-angle
	I170FJ0008	3 conductor terminal Plug-in
J1A	21-01-050972	30 pin Header .1" ctrs
J5,6	21-03-122968	5 pin Header .1" ctrs
	I170-JA-0001	2 pos shorting jmpr .1" cntr
J7	21-01-051178	3 pin Header .1" cntr
CAPACITORS		
C5,15	15-01-125026	6.8 uF non-pol Electrolytic
C4,13,8,17	15-02-124808	.1uF 50V Ceramic
C6,16	15-06-124587	.001 uF 50V Poly
C1,11	15-02-029032	15pF 50V Ceramic
C10,18,20,21	15-01-028691	10uF 50V Electrolytic
C2,3,7,12,14,19	15-02-028578	47pF 50V Ceramic
MISCELLANEOUS		
FL1,2,3,4	56-01-050483	Ferrite Bead, EMC Filter
XLR PCB mntg	28-01-124701	Screw 4-40x1/4
PCB DISPLAY (27-01-051167)		
SEMICONDUCTORS		
Q1,2,3,4,5,6	48-03-121306	2N3904 NPN Transistor
D1,5,6	39-01-051185	LED Red
D3,8	39-01-051186	LED Green
D2,7	39-01-051184	LED Amber
D4,9	48-02-042787	1N4004 Diode
RESISTORS		
R1,8,14,15	47-03-109437	10k .25W 1%
R2,3,5,7,9,10,12	47-03-121532	1k .25W 1%
R4,11	47-03-028173	100k .25W 1%
R6,13	47-03-051212	20k .5W 1%
MF W01	21-01-110310	Jmpr Circuit
MISCELLANEOUS		
J1A	21-01-051372	8 pin Header .1" ctrs
LED spacers	28-07-051183	Spacers, perm-o-pads
PCB SUPPLY AP2200 (27-01-051148)		
SEMICONDUCTORS		
U1, U2	17-02-039512	MOC3041 Opto-Triac
U3	17-01-051179	LM7806 6 volt regulator
U4	17-01-121660	LM7815 15 volt regulator
U5	17-01-121659	LM7915 neg 15 volt regulator
CR1A-CR1D	48-02-051000	Diode 6 amp 200V / AP2200
CR2A-CR2D	48-02-051000	Diode 6 amp 200V / AP2200
D1,2,3,4	48-01-122601	1N4448 Diode
D5,6,7,8,9	48-02-042787	1N4004 Diode
CR3,CR4	48-02-037580	Bridge Rectifier
Q1,3	48-02-039501	MAC224-6 600 Volt Triac
Q2,4,5,6,7	48-03-121306	2N3904 NPN Transistor
RESISTORS		
R1,R6,R13	47-01-102246	180 Ohm .5W 5%
R4,R9	47-03-028173	100k .25 W 1%
R3,R8	47-03-109437	10k .25 W 1%
R2,R5,R7,R10	47-03-121532	1k .25 W 1%
R11	47-03-028242	4.75k .25 W 1%
W1-12	21-01-110310	Jmpr Circuit
CAPACITORS		
C4,7	15-01-050971	2200uF 160V Electrolytic
C13,15,16	15-01-050970	2200uF 50V Electrolytic
C1,2,5,6	15-06-039383	.1uF 400V Metal Poly
C14,17,18	15-02-124808	.1uF 50V Ceramic
C9,10,11,12	15-02-026884	.01uF 250V Radial UL approved
MISCELLANEOUS		
K1	45-01-051144	Relay 5V
J4	21-01-050186	5 Pin Header .156" ctrs
J2A	21-02-123239	10 Pin .1" ctrs
J5A-12A	21-03-124541	.25" Spade Term
J5-12	21-03-124541	.25" Spade Term
Heatsink - Triac	14-05-027783	Heatsink Stamped tall
Htsnk - Regulator	14-05-050433	Heatsink Extruded / anodized
Regulator mntg	28-01-026899	Screw MCH 4-40
Regulator mntg	28-02-027389	Nut Keps Hex 4-40
Triac mounting	28-01-124701	Screw Rolox 4-40
PCB SUPPLY AP2400 (27-01-051149)		
SEMICONDUCTORS		
U1, U2	17-02-039512	MOC3041 Opto-Triac
U3	17-01-051179	LM7806 6 volt regulator
U4	17-01-121660	LM7815 15 volt regulator
U5	17-01-121659	LM7915 neg 15 volt regulator
D1,2,3,4	48-01-122601	1N4448 Diode
D5,6,7,8,9	48-02-042787	1N4004 Diode
CR3,CR4	48-02-037580	Bridge Rectifier
Q1,3	48-02-039501	MAC224-6 600 Volt Triac
Q2,4,5,6,7	48-03-121306	2N3904 NPN Transistor
RESISTORS		
R1,R6,R13	47-01-102246	180 Ohm .5W 5%
R4,R9	47-03-028173	100k .25 W 1%
R3,R8	47-03-109437	10k .25 W 1%
R2,R5,R7,R10	47-03-121532	1k .25 W 1%
R11	47-03-028242	4.75k .25 W 1%
W1-12	21-01-110310	Jmpr Circuit
CAPACITORS		
C3,4,7,8	15-01-050971	2200uF 160V Electrolytic
C13,15,16	15-01-050970	2200uF 50V Electrolytic
C1,2,5,6	15-06-039383	.1uF 400V Metal Poly
C14,17,18	15-02-124808	.1uF 50V Ceramic
C9,10,11,12	15-02-026884	.01uF 250V Radial UL approved
MISCELLANEOUS		
K1	45-01-051144	Relay 5V
J4	21-01-050186	5 Pin Header .156" ctrs
J2A	21-02-123239	10 Pin .1" ctrs
J5A-12A	21-03-124541	.25" Spade Term
J5-12	21-03-124541	.25" Spade Term
Heatsink - Triac	14-05-027783	Heatsink Stamped tall
Htsnk - Regulator	14-05-050433	Heatsink Extruded / anodized

REFERENCE	PART NUMBER	DESCRIPTION
Regulator mntg	28-01-026899	Screw MCH 4-40
Regulator mntg	28-02-027389	Nut Keps Hex 4-40
Triac mounting	28-01-124701	Screw Rolox 4-40
CHASSIS HARDWARE AND CABLE		
Ear mntg screws	28-01-124842	Screw # 8x1/4 Rolox B.O PHP
Driver brd hinge	28-01-124842	Screw # 8x1/4 Rolox B.O PHP
Driver brd hinge	28-04-051242	Washer Nylon Shoulder #8
Top & rear panel	28-01-121967	Screw # 6x1/4 Rolox, BO PHP
Frnt panel screws	28-01-114318	Screw # 6x1/4 MCH BO PHP
Rear Panel mntg	28-01-124580	Screw 6-32x3/16 PHP Rolox
Fan Bracket mntg	28-02-114116	Nut Keps 6-32
Fan mntg screws	28-01-110787	Screw Type B # 6x1/4 BO
Input Panel mntg	28-01-121967	Screw # 6x1/4 Rolox, BO PHP
XLR mntg screws	28-01-026899	Screw #4x5/16 MCH BO PHP
PCB Mounting	28-01-113868	Screw # 6x 5/16 MCH STL PHP
Earth ground	28-02-114116	Nut Keps 6-32
Main Heatsink	28-01-113870	Screw # 6x1/2 MCH PHD Head
Rack Mntg	28-13-026422	Hardware kit
	10-01-051243	Amp / Driver Cable
	10-01-051244	Display / Driver Cable
	10-01-051245	Pwr Supply / Driver Cable

REFERENCE	PART NUMBER	DESCRIPTION
	10-01-051247	WirePrep LD SW / Xfmr Harn
SW2, SW3	51-02-039502	Load switch DPDT 15 amp
	51-04-100459	Fuse Holder
SW1	51-02-124582	Pwr Switch
	28-09-124596	Strain Relief, Heyco
Power Cord	60-06-051246	CBL Line 18 GA
	32-08-051064	Air Filter
Fan conn housing	21-02-121395	Conn Housing 2 pos
Fan conn terminal	21-03-121397	Term Crimp
AP2400 ONLY		
	10-01-051647	WirePrep
F1	51-04-105890	Fuse 10A
	56-08-051555	Pwr Transformer
	35-01-051239	FAN-Cross-Flo 24 VDC 10.75"
CR1,2	48-02-122651	25 Amp Bridge Rect
Mntg Bridge Rect	28-02-114122	Nut Keps 8-32
AP2200 ONLY		
	10-01-051634	WirePrep
F1	51-04-051254	Fuse 7A
	56-08-051253	Pwr Transformer
	35-01-051240	FAN-Cross-Flo 24 VDC 4.6"

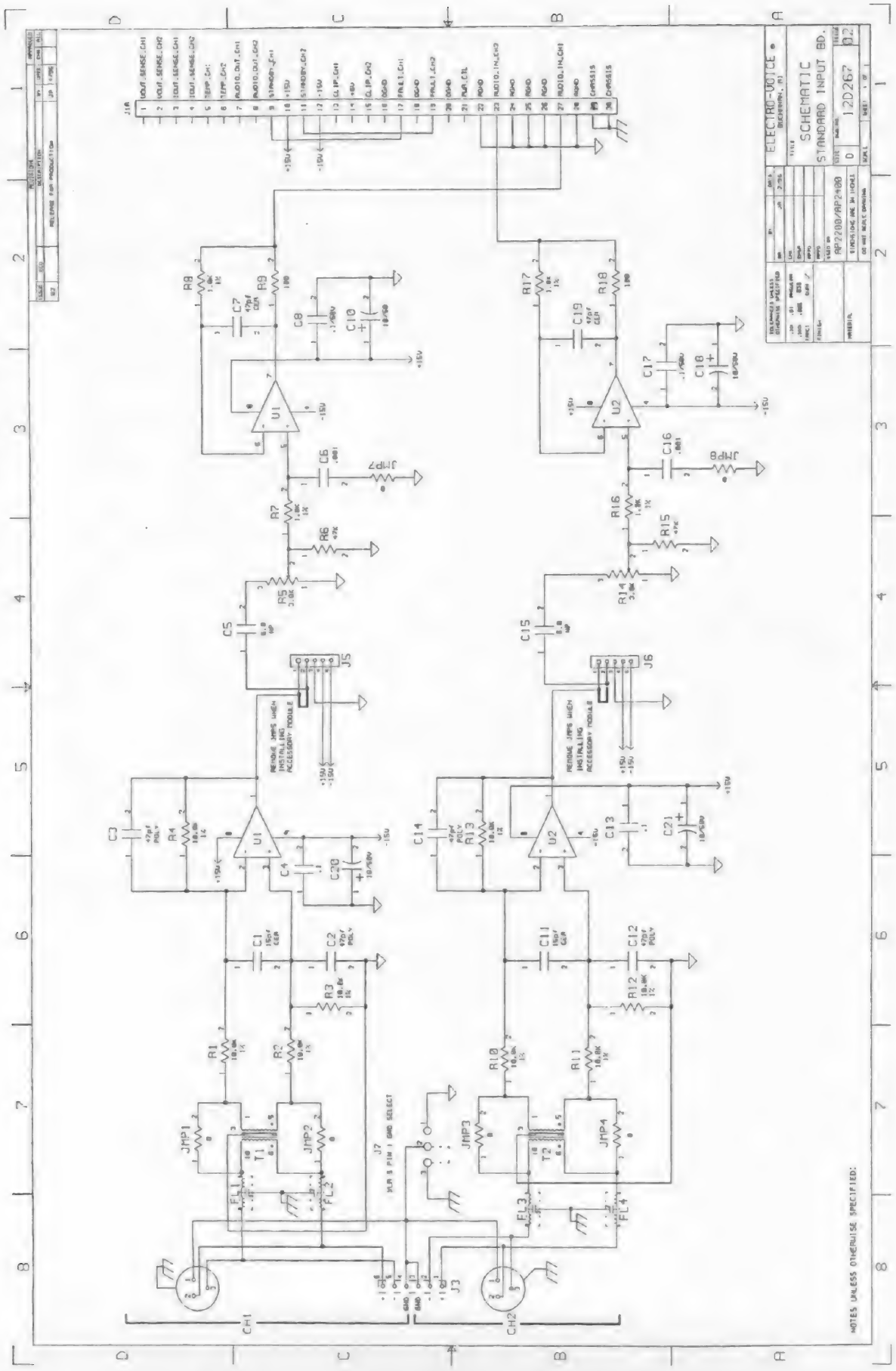
INPUT CARD PIN ASSIGNMENTS

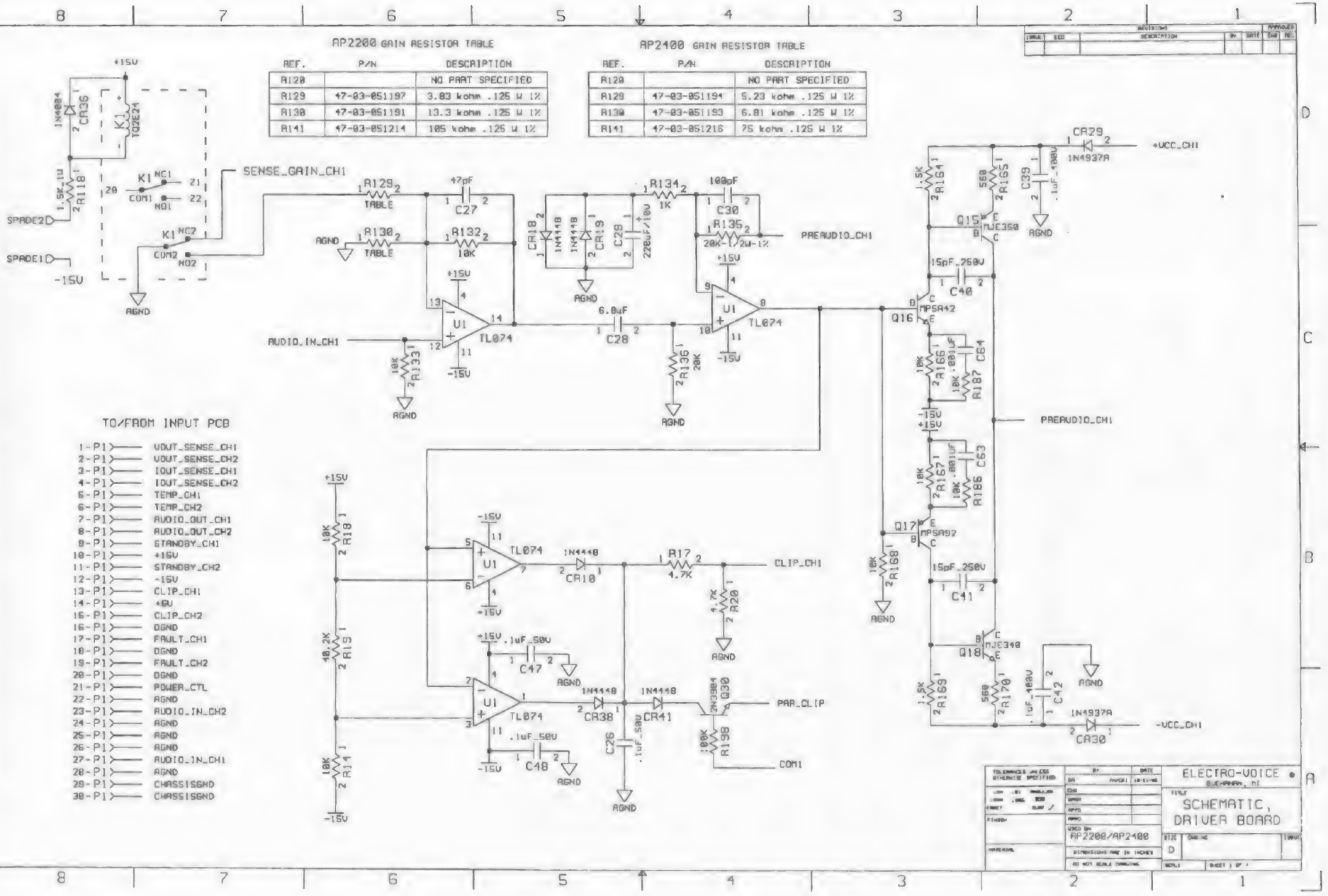
The input module connects to the amplifier via a 30-pin connector. The amplifier provides various signals and controls through this connector. The following is a brief description of each pin function.

PIN#	NAME	FUNCTION
1	VOUT_SENSE_CH1	0 to 5 Volt DC signal that represents the load voltage for channel 1.
2	VOUT_SENSE_CH2	Same as above but for channel 2.
3	IOUT_SENSE_CH1	0 to 5 Volt DC signal that represents the load current for channel 1.
4	IOUT_SENSE_CH2	Same as above but for channel 2.
5	TEMP_CH1	0 to 5 Volt DC signal that indicates the channel 1 heat sink temperature. Scale is 25 to 100°C.
6	TEMP_CH2	Same as above but for channel 2.
7	AUDIO_OUT_CH1	Channel one output scaled down for 0 dBu full scale. Can be used for monitoring or line out.
8	AUDIO_OUT_CH2	Same as above but for channel 2.
9	STANDBY_CH1	Control signal turns channel 1 power supply on by forcing pin to agnd. Normally it is connected to the channel 1 fault signal pin 17.
10	+15V	15 volt DC supply with 100 mA capacity.
11	STANDBY_CH2	Same as pin 9 but for channel 2.
12	-15V	-15 volt DC supply with 100 mA capacity.
13	CLIP_CH1	0 to 8 volt signal. Indicates a clip condition by going high (> 4 volts).
14	+5V	6 volt DC supply with 800 mA capacity reference only to DGND.
15	CLIP_CH2	Same as pin 13 but for channel 2.

PIN#	NAME	FUNCTION
16	DGND	Reference for 6 volt DC supply (pin 14).
17	FAULT_CH1	Normally connected to STANDBY_CH1. Indicates either critical temperature, over-current, output DC or shorted output devices by going high (> 5 volts). Normally this signal is low (< 1 volt). It is referenced to AGND.
18	DGND	Same as pin 16.
19	FAULT_CH2	Same as pin 17 but for channel 2.
20	DGND	Same as pin 16.
21	POWER_CTL	Shorting this pin to DGND will power down the entire amplifier with the exception of the 6 volt DC supply.
22	AGND	Analog, fault and +15 volt supply ground reference.
23	AUDIO_IN_CH2	Input to power amplifier. Unbalanced and referenced to AGND. Sensitivity is 0.775 Vrms.
24	AGND	Same as pin 22.
25	AGND	Same as pin 22.
26	AGND	Same as pin 22.
27	AUDIO_IN_CH1	Same as 23 but for channel 1.
28	AGND	Same as pin 22.
29	CHASSISGND	Connects to the chassis ground inside of the amplifier.
30	CHASSISGND	Same as above.

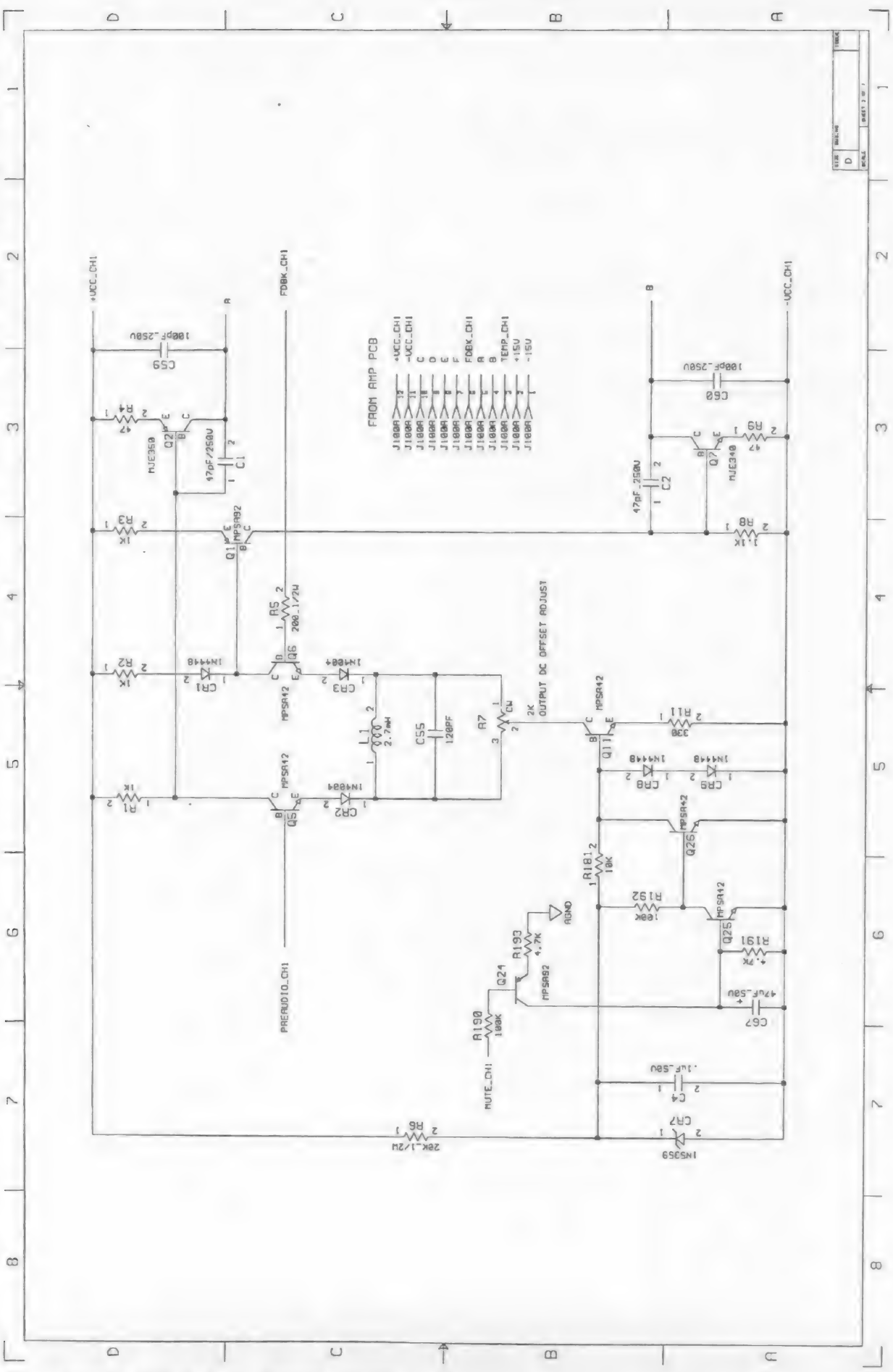
SCHEMATICS/INPUT BOARD

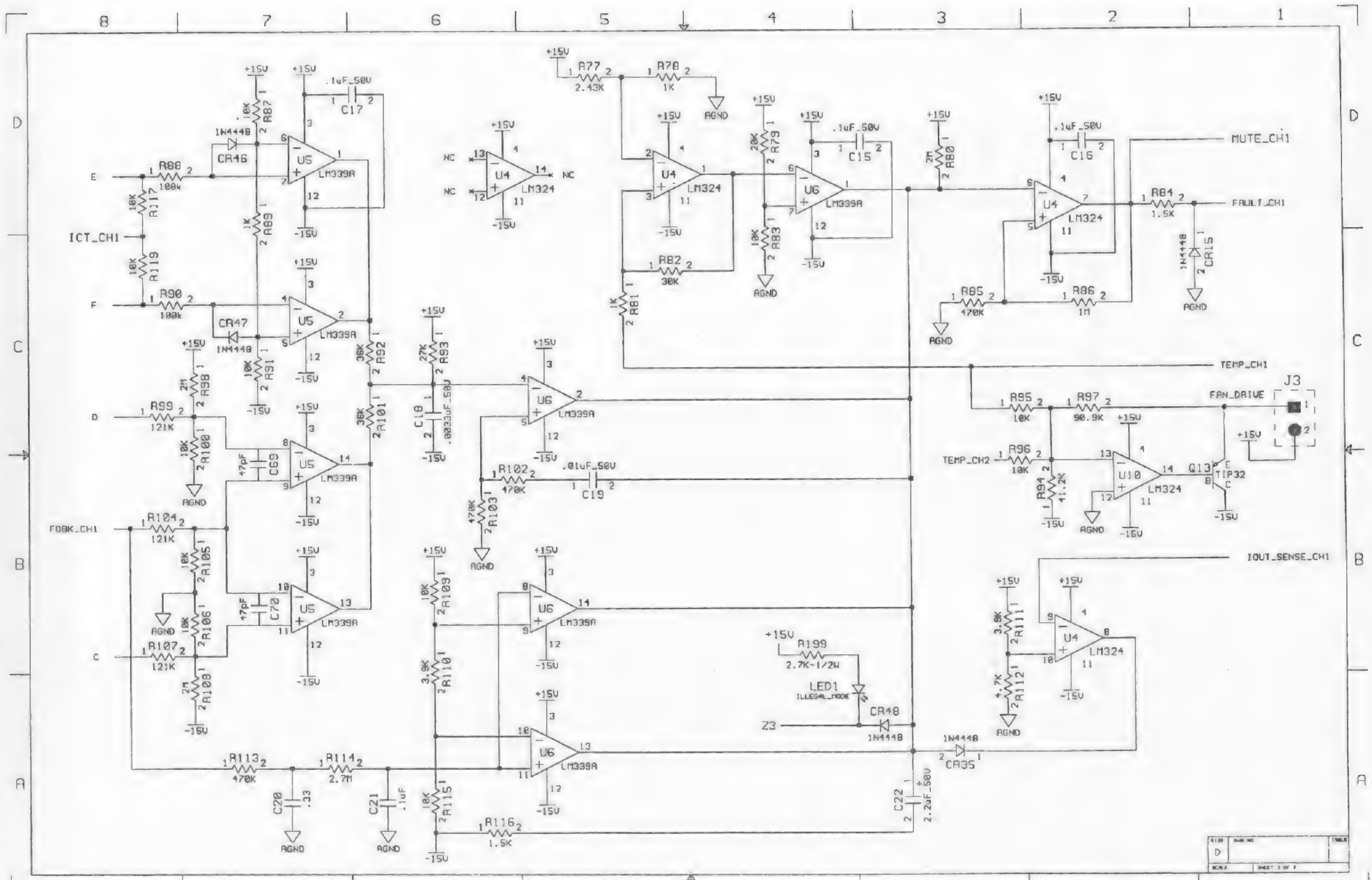




SCHEMATICS/DRIVER BOARD

SCHEMATICS/DRIVER BOARD





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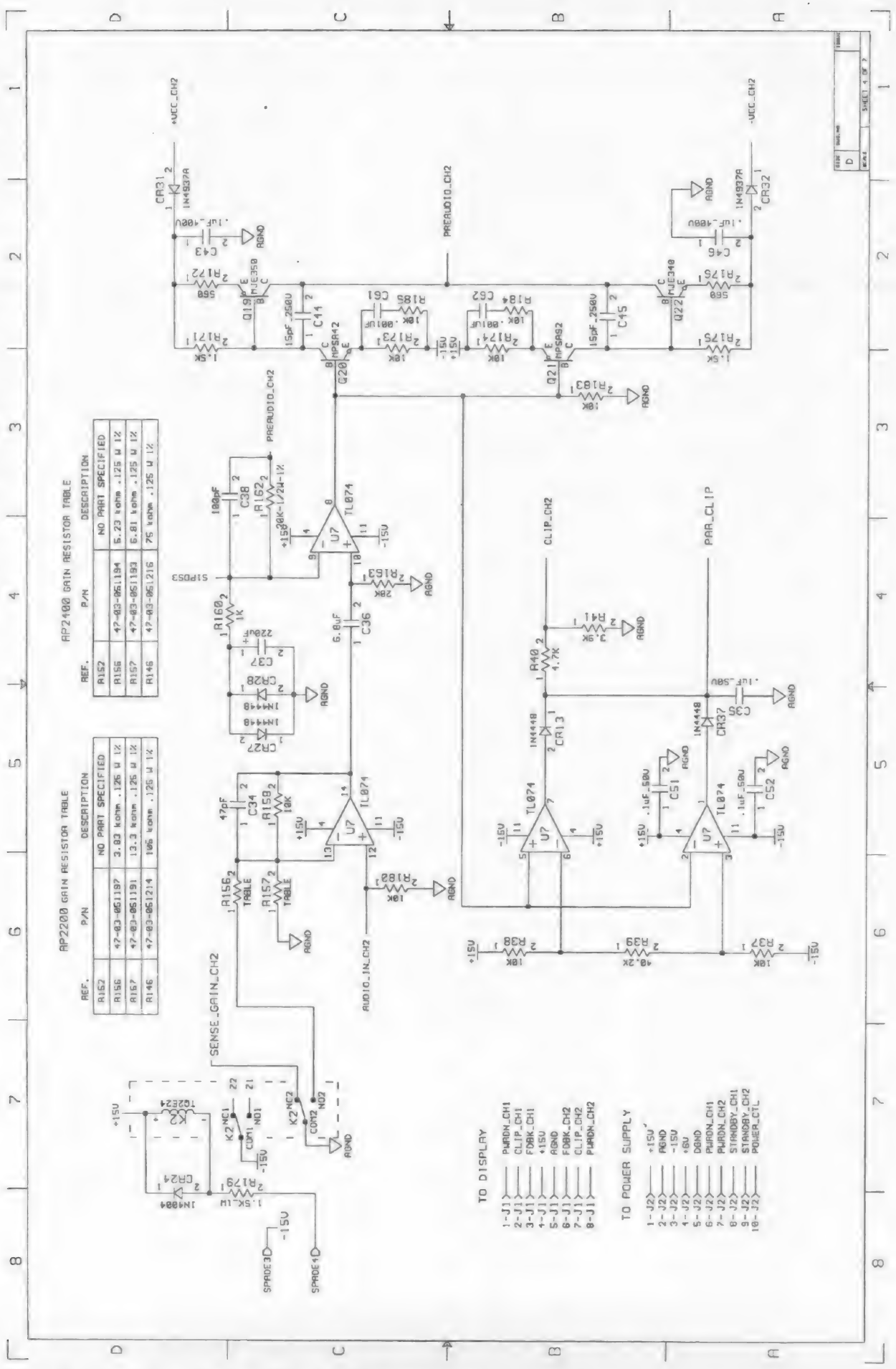

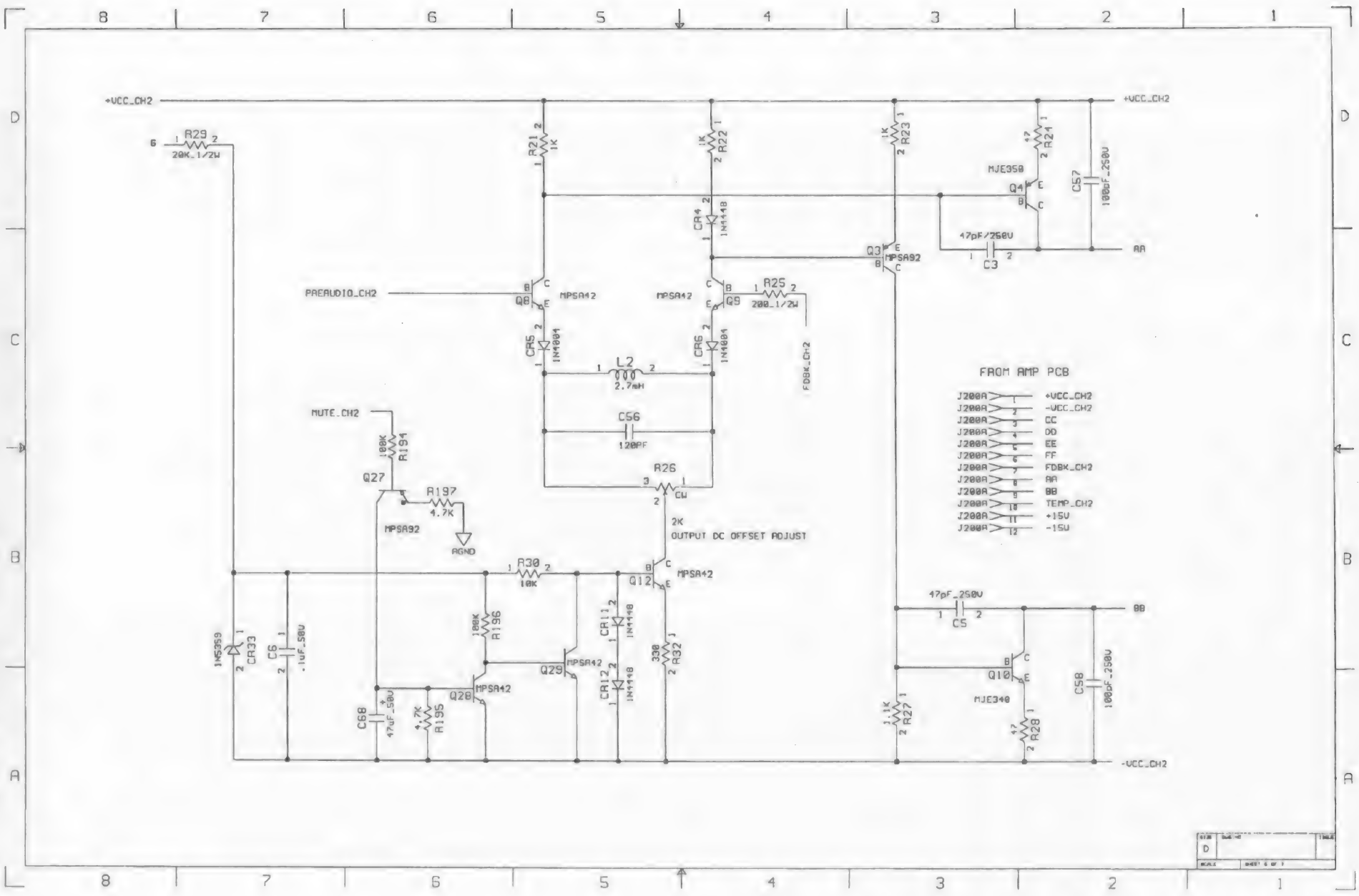

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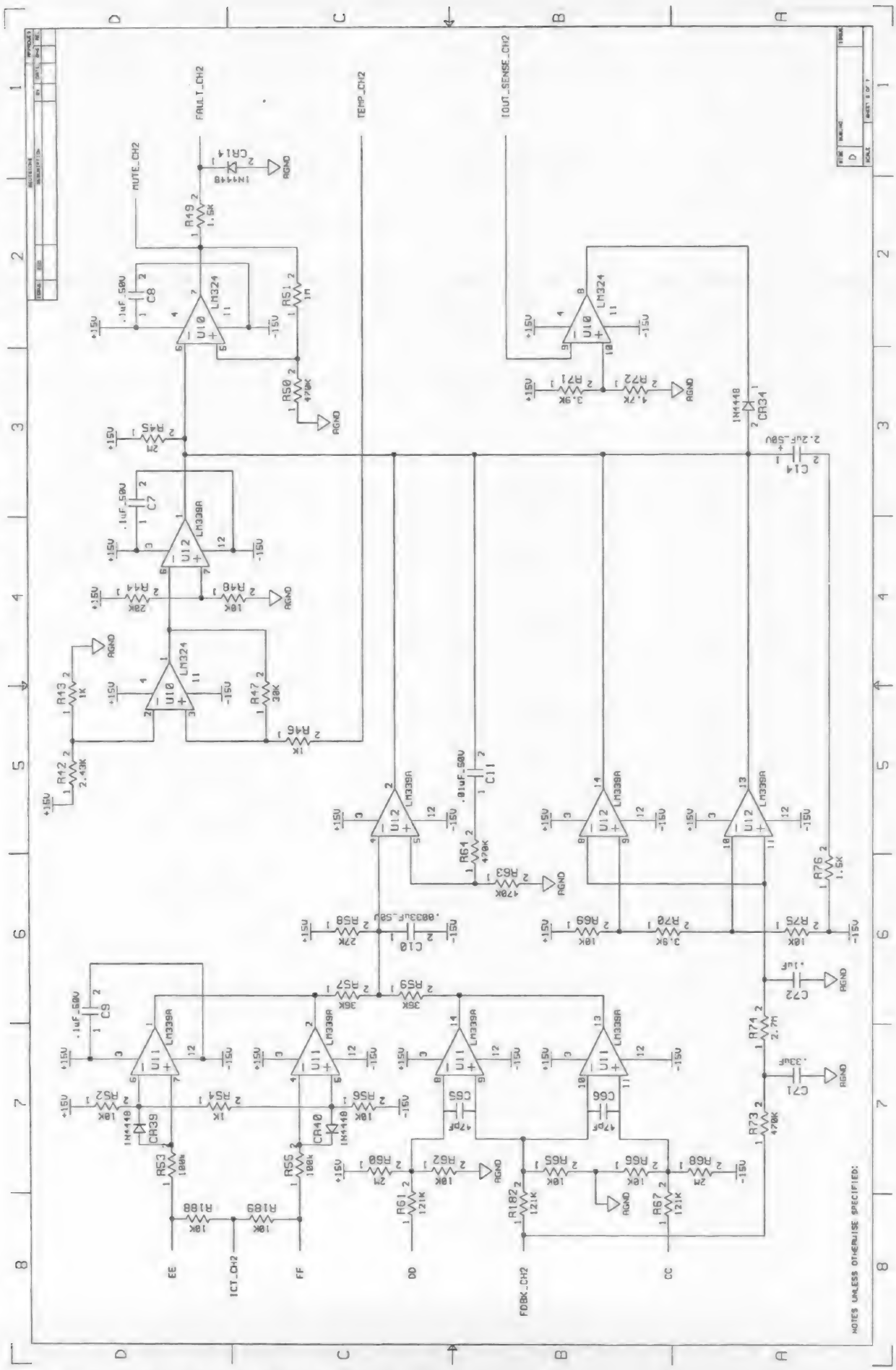
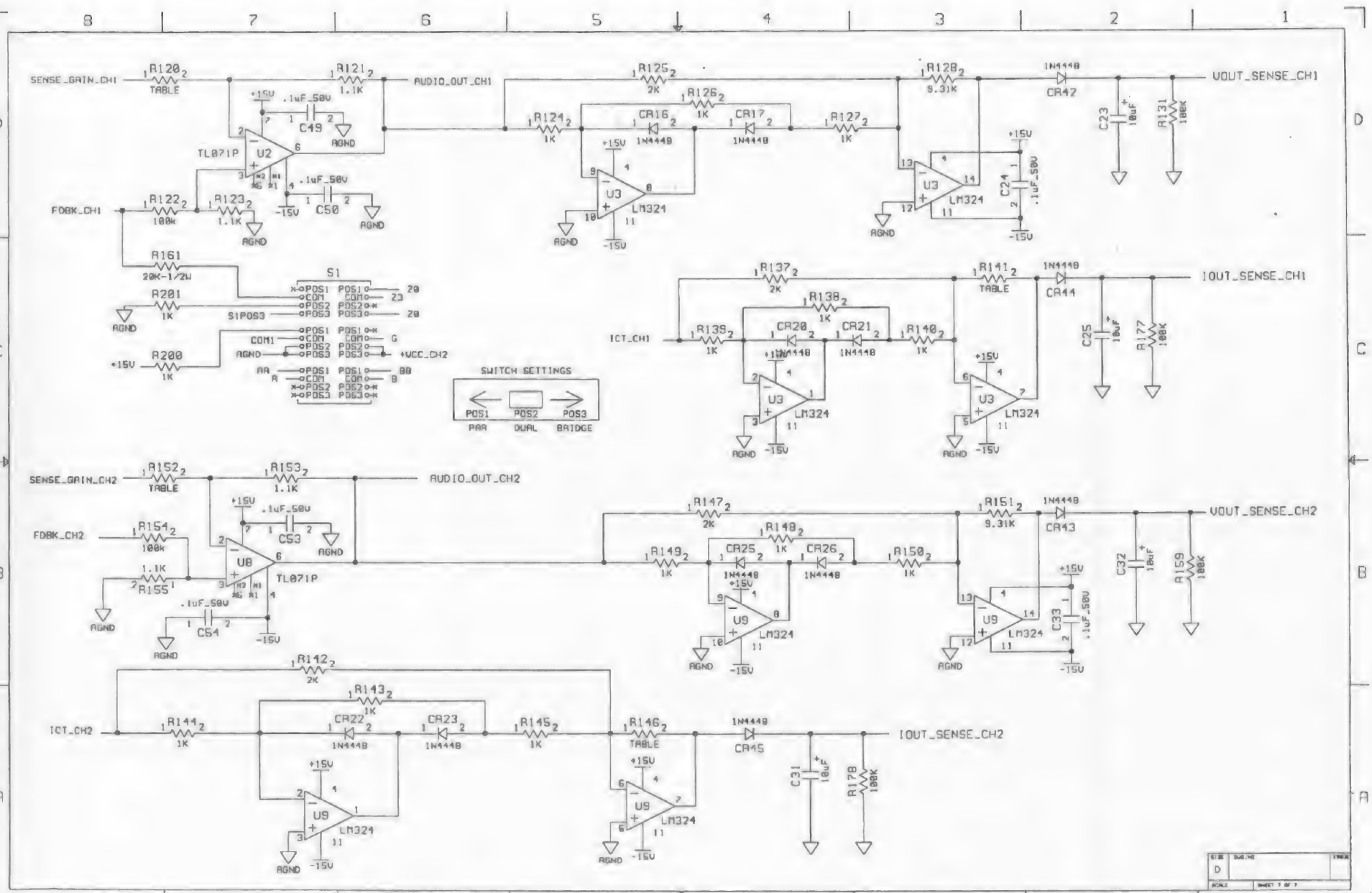
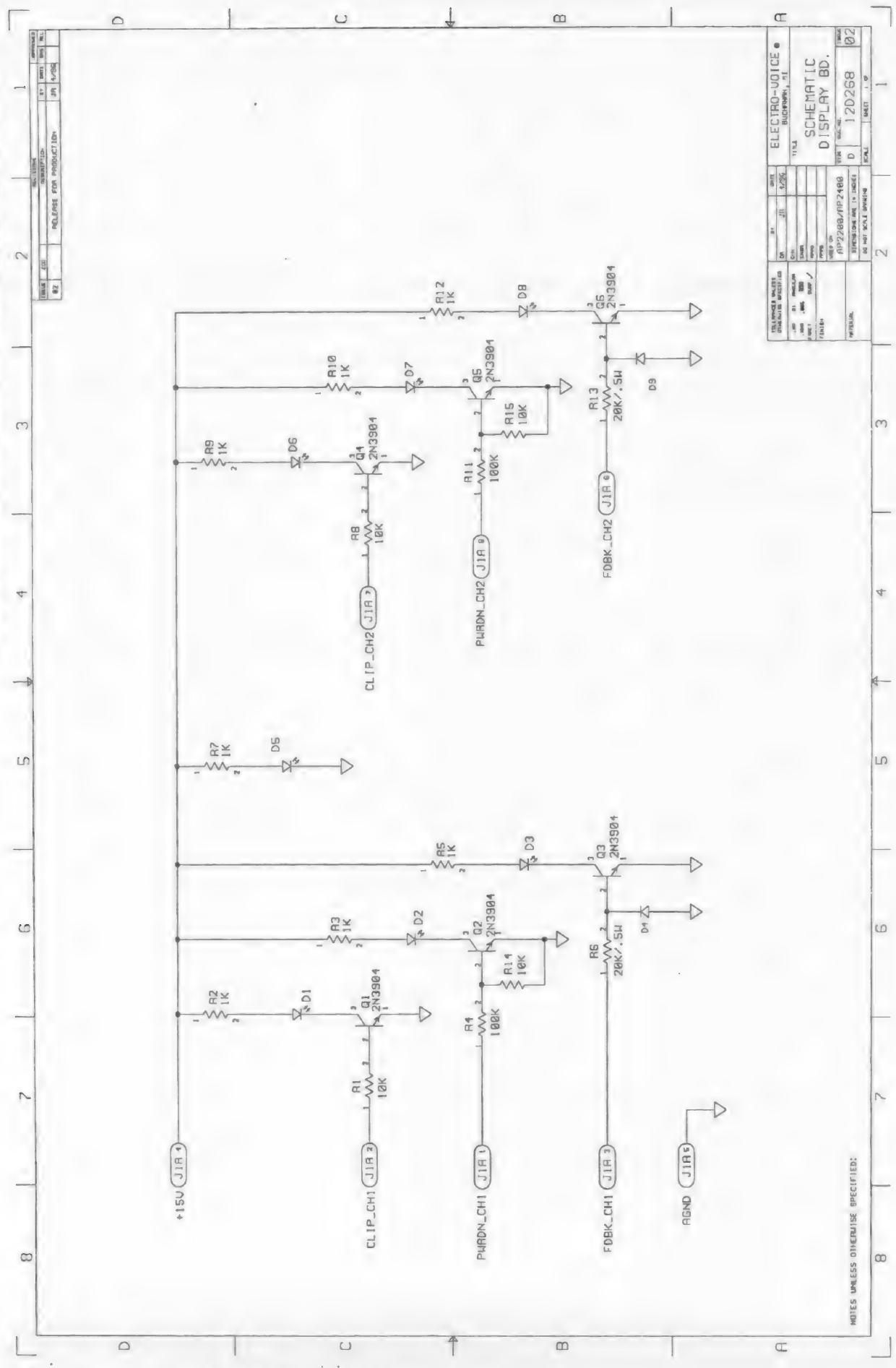
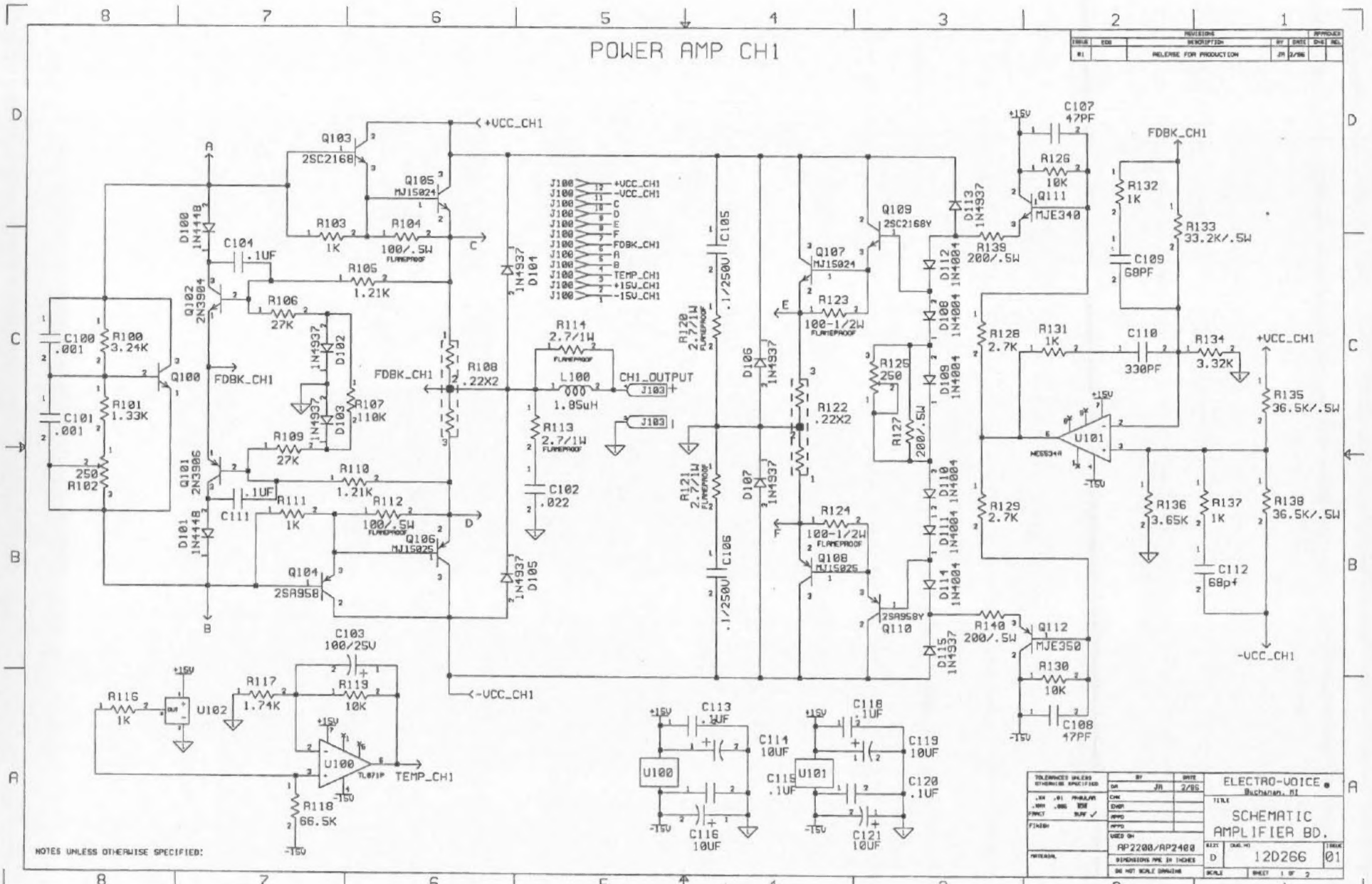




SCHEMATICS/DRIVER BOARD

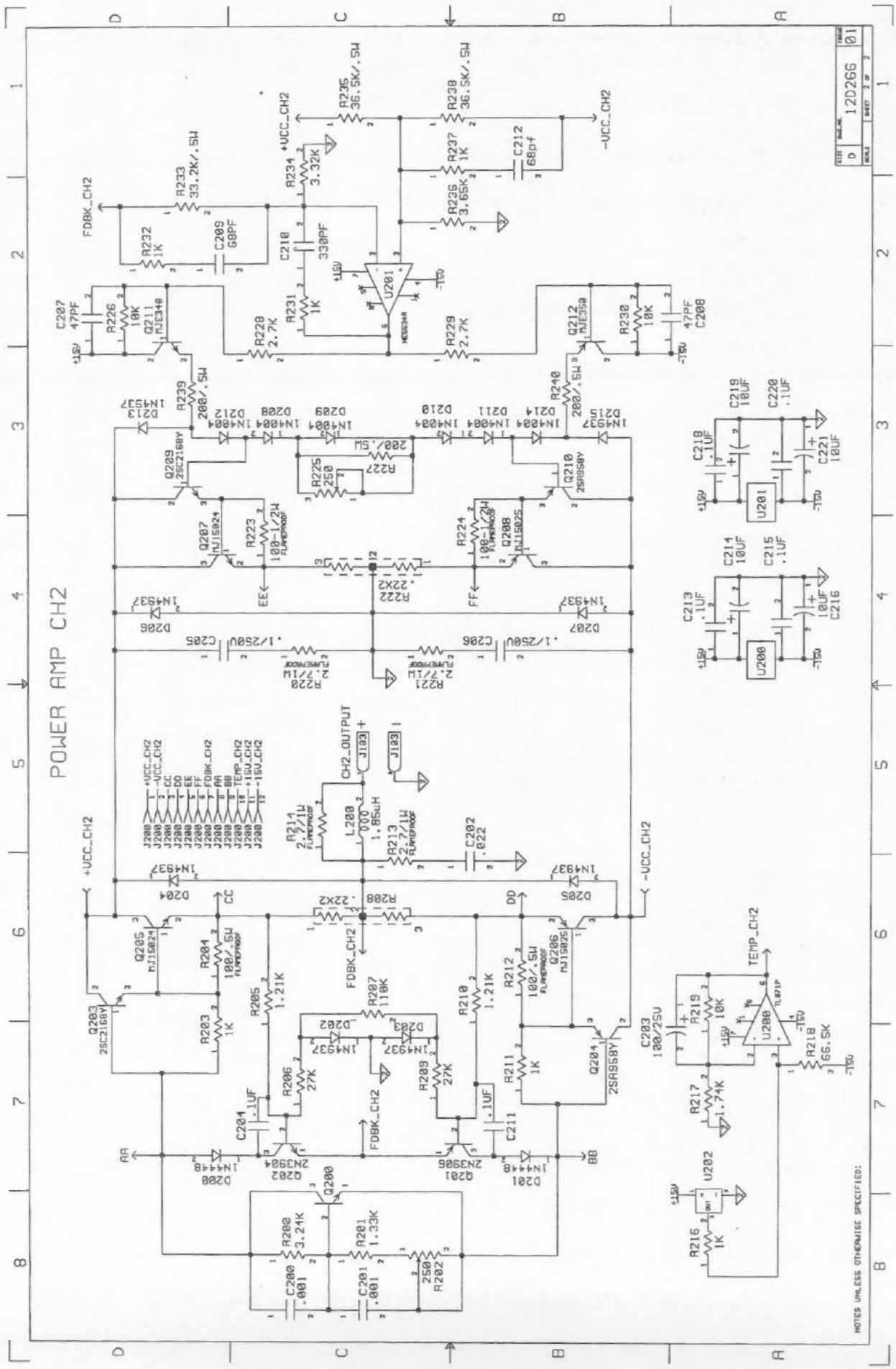
SCHEMATICS/DISPLAY BOARD

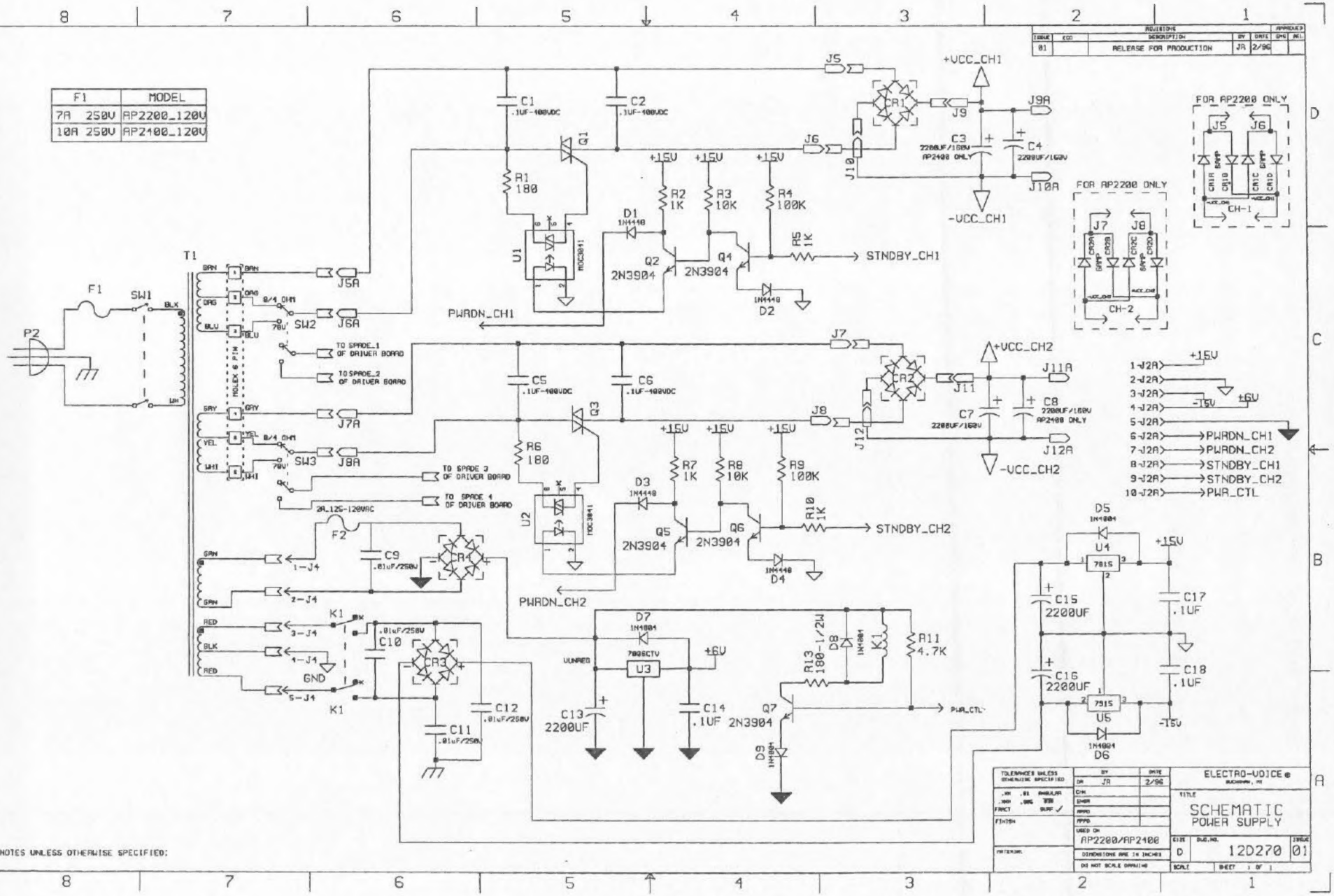




SCHEMATICS/POWER AMP CHANNEL 1

SCHEMATICS/POWER AMP CHANNEL 2





SCHEMATICS/POWER SUPPLY BOARD

Electro-Voice

FACTORY SERVICE

If there is not an authorized service representative in your area you can ship the unit in its original packing prepaid to:

Mark IV Audio Service
600 Cecil Street
Buchanan, MI 49107
USA

OR

Mark IV Audio Service
9130 Glenoaks blvd
Sun Valley, CA 91352

For a listing of authorized service representatives write to:

Mark IV Audio Service
600 Cecil Street
Buchanan, MI 49107
USA

or call: 1-800-234-6831 or FAX 616-695-4743

To obtain warranty service, a customer must deliver the product, prepaid, to Mark IV Audio Service or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice.

TECHNICAL ASSISTANCE

For applications assistance or other technical information, call: 1-800-234-6831

ACCESSORIES

For information on accessories contact
Mark IV Audio Service at
1-800-234-6831 or FAX 616-695-4743

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